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ABSTRACT

This report describes and justifies a data-collection system for assessing teacher supply and demand in United States elementary and secondary schools. The resulting data-collection effort consists of linked surveys of school districts, schools, principals, and teachers designed to support analyses of teacher supply and demand using dimensions such as qualifications, assignments, and working conditions; and school conditions, policies, and staffing practices. The main objectives of the study are to lay the groundwork for prescribing data requirements and data-collection procedures for the Schools and Staffing Surveys database administered by the Center for Education Statistics. The purpose is to gather information that will enable educators and researchers to assess the current status of teachers on numerous dimensions, and to provide data that will support analyses of flows into, out of, and within the teacher workforce. (JD)

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Assessing Teacher Supply and Demand

Gus W. Haggstrom, Linda Darling-Hammond, David W. Grissmer

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40 Years 1948-1988

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PREFACE

This report describes and justifies a data-collection system for assessing teacher supply and demand in U.S. elementary and secondary schools. It was prepared as part of a survey design project conducted by RAND for the Center for Education Statistics in the U.S. Department of Education. The resulting data-collection effort—the Schools and Staffing Surveys—consists of linked surveys of school districts, schools, principals, and teachers designed to support analyses of teacher supply and demand; teacher qualifications, assignments, and working conditions; and school conditions, policies, and staffing practices. The surveys are being fielded in 1988 by the Center for Education Statistics in collaboration with the Bureau of the Census.

The report should be of interest to policymakers and analysts concerned with assessing the supply of and demand for teachers and to future users of the Schools and Staffing Surveys data base.

SUMMARY

This report presents an analysis of factors that affect the supply of and demand for elementary and secondary school teachers. This analysis was undertaken to guide the design of a data-collection system for monitoring the teacher workforce at a time when the nation's schools are in a state of flux, teacher shortages seem to be on the rise, and concerns about teacher quality are mounting.

The main objective of this study was to lay the groundwork for prescribing data requirements and data-collection procedures for the Schools and Staffing Surveys administered by the Center for Education Statistics (CES).[1] These surveys, to be fielded by the Bureau of the Census in 1988, are CES's major vehicles for collecting information on the nation's teachers, school staffing patterns, and factors related to teacher supply and demand.

Several linked surveys are the sources for this information:

- The Teacher Demand and Shortage Survey—a survey of local education agency (LEA) administrators and private school heads;
- The Public and Private School Surveys—surveys of principals of public schools in the same LEAs and private school heads;
- The Public and Private School Teacher Surveys—surveys of teachers sampled from the same public and private schools; and
- Follow-Up Survey of Teachers—a follow-up survey of teachers who left their teaching positions during the year following the base year survey and a subsample of continuing teachers.

The main purposes of these surveys are (1) to gather information that will enable educational decisionmakers and the public to assess the current status of teachers on numerous dimensions and (2) to provide data that will support analyses of flows into, out of, and within the teacher workforce. With the exception of the Follow-Up Survey of Teachers, the other surveys have been conducted previously, but they were not specifically designed to assess teacher supply and demand.

Although other national and state data bases can be tapped to provide information on the nation's teachers, our review of available data sources leads us to conclude that the current data base on teachers is insufficient to profile the nation's teacher force or to support

[1]Formerly the National Center for Education Statistics (NCES).

assessments of teacher supply and demand. There do not exist reasonably accurate overall counts of teachers for any recent year, let alone disaggregated counts by field, location, level (elementary and secondary), and sector (public and private). Because basic information is lacking about teacher qualifications, demographic characteristics, teaching loads, salary and income levels, mobility patterns, and turnover rates, educational scholars who rely on CES publications and data bases can paint only a gross picture of the current condition of teaching. Without current, accurate information, they can only speculate about what the immediate future holds.

As is shown in Secs. II–IV, teacher supply and demand are difficult notions to quantify, partly because they depend on a multitude of local factors that affect the employment decisions of prospective and current teachers. Also, assessments of supply and demand depend on qualitative distinctions that underlie categorizations of teachers, such as *qualified, certified, competent,* and *out-of-field.* This means that teacher *shortages*, the focus of Sec. V, can be defined and quantified in numerous ways, and that attempts to gauge the severity of current shortages are beset by difficulties associated with defining and counting vacancies, mismatches, and positions filled by marginally qualified teachers. It also means that a national data base for examining the condition of teaching must be very comprehensive to permit isolating imbalances in supply and demand by state, sector, level, and field.

Section VI examines projections of teacher supply and demand, concentrating on the methodology underlying CES's often-cited national projections as a prototype of forecasts that can be carried out at other levels of aggregation. This examination shows that teacher turnover is the dominant factor in projections of the demand for new teachers and underscores the need for far more detailed data on flows of teachers into, out of, and within the teacher workforce.

The implications for data requirements that flow from these analyses are discussed in Sec. VII. The specific options that we have recommended to CES to meet those requirements are outlined in Sec. VIII and are summarized in Sec. IX.

In brief, we find that the current data base on teachers is woefully deficient for assessing the condition of teaching in the nation's schools. CES cannot provide reasonably accurate counts of teachers by level and sector for any year since 1980, let alone the detailed information about teachers and schools that is needed to gauge the severity of school staffing problems or to pinpoint teacher shortages by state, sector, level, and field.

The first step toward remedying this situation is to reestablish the machinery for fulfilling CES's mission to report full and complete

statistics on the nation's schools—both public and private. At a minimum, this means gathering data to provide consistent, reliable time series of counts of teachers and enrollments by grade level in all public and private schools. CES's Common Core of Data, if updated annually on a timely basis, serves this function for the public schools. To fill the gap in the private sector, we recommend creating and maintaining an up-to-date "private school directory" that lists basic information (names, addresses, enrollments by grade, and numbers of teachers) for all private schools.

Once these gaps in the CES data base are filled, the four surveys that we have helped redesign should constitute the right types of data-gathering efforts to provide information for assessing the condition of teaching, but they need to be reoriented to concentrate on key dimensions of teacher supply and demand. In particular, school- and district-level data are needed to provide estimates of (1) numbers of teachers by field, certification status, and sources of entry; (2) teacher shortages by field; and (3) teacher turnover by field and teachers' reasons for leaving.

To complement these efforts, we recommend expanding CES's surveys of public and private school teachers to gather far more comprehensive information on teachers' assignments, qualifications, work history, demographic characteristics, marital and family status, and sources of personal and family income. Finally, we recommend fielding the Follow-Up Survey of Teachers in 1989 to determine former teachers' reasons for leaving, current activities, salary and income levels, and plans for reentry into teaching and also to provide comparable information on a subsample of continuing teachers in the same schools. These data are essential for determining who leaves teaching and why.

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I. INTRODUCTION

This report presents an analysis of factors that affect the supply of and demand for elementary and secondary school teachers. The analysis was undertaken to provide a framework for designing a national data base to monitor the status of the nation's teachers over the next several years—a period in which the teacher workforce will undergo substantial change. The report reviews both the theoretical and the practical considerations that need to be weighed in specifying data requirements and data-collection procedures for identifying school staffing problems and assessing supply and demand trends as they are shaped by school and labor market conditions.

THE CLOUDED OUTLOOK FOR TEACHER SUPPLY AND DEMAND

The next decade will be a time of enormous change in the teaching occupation. Well over one million teaching positions will have to be filled between now and 1995. The qualifications and capabilities of these new teachers and the conditions under which they will work are of substantial importance. Just as the teaching force is experiencing greater change than it has in the previous two decades, education policymakers have embraced far-reaching reforms of the entire educational system. And one major object of these reforms is the teaching workforce itself.

Over the past few years a number of major reports on the condition of American education have voiced concerns about educational quality and outcomes and have urged reform in the curricula and programs offered to students as well as in the quality of the teaching force itself. Meanwhile, growing reports of teacher shortages in particular teaching fields and locations combined with visible declines in the numbers of college students entering teaching have raised the specter of an inadequate supply of qualified teachers to satisfy even minimal needs, much less the demands suggested by other reform initiatives.

Despite the urgency of these matters and the proliferation of policy activity in states and localities to address the perceived problems of teacher supply and quality, little information is available to establish the extent and magnitude of these trends. Existing data are even less adequate for diagnosing the current status and future prospects for teacher supply and demand that indicate the sources of imbalances and

suggest appropriate targets for policy. Federal and state data-collection efforts have been impeded by the cyclical nature of interest in supply and demand, which comes and goes with periods of shortage and surplus; the lack of funding for such data collection; and a lack of consensus about what data ought to be collected and how it might be most usefully analyzed.

This report discusses the major components that must be considered in assessing the nation's teaching force, outlines data requirements for monitoring teacher supply and demand, and describes data-gathering options for meeting those requirements. This discussion is intended to inform federal data-collection and analysis efforts in three major areas:

1. The estimation and projection of teacher supply and demand by teaching field and at appropriate levels of disaggregation;
2. The development of meaningful indicators of teacher surplus or shortage; and
3. The examination of demographic, social, and institutional factors that influence the current and prospective future supply, quality, and composition of the teaching force.

These issues, which have received periodic but not sustained attention in the past, are particularly important now that demographic and social changes are converging to produce extraordinary volatility in the structure of the teaching profession and the character of the teaching force. Upswings in the number of elementary students and apparent downturns in the number of college students entering teaching are occurring at a time when both educational policies and labor force behaviors are changing in important ways.

Changes in the Teacher Labor Market

From a national perspective, the teacher market appears to be shifting from a state of surplus to one of shortage. In the past few years, at least spot shortages have been reported in certain teaching areas, particularly in secondary school specialties such as mathematics, physics, computer programming, chemistry, data processing, bilingual education, special education, earth science, biology, and English (Howe and Gerlovich, 1982; Association for School, College, and University Staffing, 1984). The shortages in mathematics and the physical sciences seem particularly severe (National Science Board, 1985, Chap. 6), but other teacher areas that formerly showed surpluses seem to be joining the list.

National projections have suggested that the shortages of specialized teachers will worsen—that a more general shortage of qualified

teachers will develop within the next few years. After a decade of declining enrollments in elementary and secondary schools, a baby boomlet that began in the early 1980s will lead to enrollment increases starting in 1985. At the same time, the college-age population from which many potential teachers are drawn will continue to decline through the remainder of the decade.

The proportion of college students choosing a major in education has been declining since 1970 (National Education Association, 1983). Although a slight upsurge in the percentage of college freshmen expressing interest in education majors and careers has been noted since 1983 (Astin et al., 1987), the numbers are still much smaller than a decade earlier, and it is not yet clear how many of these students will ultimately choose teaching. As will be seen in Sec. VI, CES projections based on current trends in the school-age population and data on prospective entrants to the teaching profession indicate that the supply of new teacher graduates will satisfy less than 70 percent of the demand for additional teachers beginning in 1988.

However, these projections and perceptions of current shortages do not adequately describe the state of the teacher labor market in a way that is predictive of future events or useful for policy formulation. Although personnel administrators in many states and school districts perceive shortages of qualified applicants, national surveys reveal relatively few unfilled vacancies. Moreover, projections of supply that do not take into account entrants other than recent college graduates may significantly overestimate the gap between supply and demand.

These inconsistencies and undercounts are not the only problems in assessing the outlook for teacher supply and demand. What is critical for describing the teacher labor market is an understanding of (a) factors that influence individuals' decisions to teach and then to remain in teaching (in particular fields and locations) and (b) factors that determine which individuals will be deemed qualified to teach. In the first category we must consider attributes of the pool of potential teachers and attributes of teaching as an occupation relative to other alternative occupations open to similarly qualified individuals. In the second category we must consider state and local certification policies and hiring practices as these interact with other policies and conditions that create teacher demand.

Changes in School Policies and Conditions

Educational policy decisions that will affect the demand for teachers include new course requirements for students and pressures for school improvement that may lead to lower student/teacher ratios. Teacher supply will be affected by changes in certification standards, the spread of teacher competency testing, and factors associated with the teaching environment and levels of compensation. Besides these factors, which are affected by educational policy decisions, there are factors outside the control of policymakers, such as changing wages in other occupations, the availability of alternative careers (especially for women), and changes in basic family formation and labor force participation patterns, which determine when and how many individuals marry, have children, and work.

It is important not only to develop a national picture of teacher supply and demand but to determine how the gaps between supply and demand will be distributed across regions and types of school districts. There are good reasons to believe that imbalances between supply and demand are distributed unevenly. Population trends, access to pools of potential teachers, and policies affecting supply and demand all vary across regions, states, and localities. These factors may vary by teaching field as well. The prospects of encountering and resolving shortages are also likely to differ across districts. Salary adjustment and increased recruiting intensity are likely in higher income areas; these districts are not only likely to win the competition for new teachers but they may pull existing teachers out of districts with lower salaries and less attractive working conditions. It is also the case that fertility patterns that cause the increase in elementary school enrollments are not uniform across types of school districts, probably resulting in larger growth in lower-income areas. Stiffer course requirements in mathematics and science could create differential new demand among urban, suburban, and rural area high schools, since more students in suburban schools would probably already meet new requirements.

Predicting the likely location and extent of imbalances under current educational policies is an important first step. Another purpose for federal data collection and analyses of supply and demand is to be able to evaluate the effects of changed policies on the extent and location of shortages, and the effects of policies and labor market conditions on the supply and quality of teachers. State-level policymakers have begun to respond in two ways to emerging indications of teacher shortages and declines in the measured academic ability of those entering teaching. On the one hand, they have been raising standards for entry to teaching by testing candidate teachers at various points. On

the other hand, they have responded to shortages by relaxing requirements to allow those not trained as teachers to enter teaching. School administrators, faced with an increasing demand for teachers in some areas and a shrinking supply of qualified teachers—especially in certain secondary school subject areas—must either hire inexperienced teachers with minimal qualifications or entertain stopgap changes in course offerings, teacher reassignments, and field-switching among continuing teachers. At present, only limited information exists to track the consequences of these policy changes on the actual supply and quality of the teacher labor force and on the educational offerings available to students.

THE NEED FOR AN ADEQUATE DATA SYSTEM

In the past, the teacher labor market has been characterized by seemingly abrupt shifts between shortage and surplus, with lagged responses on the part of training institutions and policymakers to current conditions. These responses have in turn produced the next boom-and-bust cycle, since adequate means for projecting their effects in the context of changing labor market conditions have not been applied. We are currently entering one of these volatile periods, produced in part by the policy responses to teacher surpluses in the 1970s that were projected to continue for some time. Other societal factors, though, have had independent effects on the teacher labor market. These, too, must be understood in developing and interpreting projections of teacher supply and demand.

Assessing teacher supply and demand trends at the national level is complicated for several reasons: Conditions influencing supply and demand differ by labor market, by teaching field, and by teaching levels; measures of supply, which include teacher qualifications for their teaching assignments, are difficult to obtain; and, most important, major structural shifts in the economy and the labor force are not easily incorporated in projections. These structural factors—for example, changes in labor force behavior and family formation patterns, particularly of women; changes in occupational choice determinants of current and prospective teachers; and policy-generated changes in supply and demand—must be considered if sound projections and indicators that can support policy decisions are to be developed.

This report incorporates a structural perspective on teacher supply and demand—one that examines the factors influencing supply and demand and explores the assumptions underlying supply and demand models. In what follows, we examine available information on supply

and demand; discuss supply and demand models, issues, and projection methods; outline data requirements for assessing and projecting teacher supply and demand by region or locality, level, and field; and propose options for meeting these data requirements.

II. THE TEACHER WORKFORCE

Our investigation of factors influencing teacher supply and demand and their implications for data requirements begins with an examination of the teaching force and of the teaching occupation. Below we briefly profile teachers, their preparation and qualifications, their mobility within and across jobs and locations, and attributes of teaching as a career. Our examination includes a review of extant data on teacher characteristics that are relevant for analyzing trends in teacher supply and demand.

TEACHERS AS A SUBPOPULATION OF THE LABOR FORCE

Data from the March 1984 Current Population Survey, U.S. Bureau of the Census, 1984, indicate that the average teacher is 39 years old, has 4.9 years of college education, works 42.9 hours per week, and earns $20,649 per year. More than two-thirds of teachers are women. Thirteen percent are members of minority groups and 54 percent live in metropolitan areas. Compared to the general population of college-educated workers, teachers are older, have completed more years of college, earn less, and are more likely to be female or a member of a minority group (see Table 1).

Table 1

CHARACTERISTICS OF TEACHERS AND NONTEACHERS IN THE COLLEGE-EDUCATED U.S. WORKFORCE, 1984

Characteristic	Teachers	Nonteachers
Percent female	67.5	33.8
Percent minority	12.6	10.0
Age	39.2	37.2
Years of college	4.9	4.5
Percent urban	54.4	72.8
Annual earnings	$20,649	$27,525
Weekly hours	42.9	42.9

SOURCE: Compiled from U.S. Bureau of the Census, Current Population Survey, March 1984.

Although accurate estimates of the total number of elementary and secondary teachers have not been available since 1980, CES estimates that the total number of full-time equivalent (FTE) teachers has been relatively stable at around 2.5 million since 1975 (NCES, 1985b). During this period, there has been some aging of the teacher workforce, with the proportion of teachers in the 20–24 age group dropping from 10.2 percent in 1976–77 to 4.5 percent in 1983–84, and the proportion younger than 35 dropping from 53.2 percent to 37.2 percent (see Table 2).

Interestingly, these statistics indicate that the proportion of teachers age 55 and over remained quite stable during this period with only a slight increase from 9.5 percent in 1976–77 to 10.0 percent in 1983–84. The analogous percentages of teachers in the 60 and over age group were 3.8 percent in 1976–77 and 4.3 percent in 1983–84, indicating some graying of the teaching force but only a marginal increase in the numbers of teachers approaching retirement. Since these statistics and

Table 2

PERCENTAGE DISTRIBUTION OF TEACHERS BY AGE GROUP, 1976–77, 1980–81, AND 1983–84

Level of School and Age Group	1976-77	1980-81	1983-84
All teachers			
20 to 24	10.2	6.8	4.5
25 to 34	43.0	37.4	32.7
35 to 44	21.4	28.3	35.4
45 to 54	15.9	18.1	17.4
55 and over	9.5	9.5	10.0
Elementary teachers			
20 to 24	11.2	7.2	5.0
25 to 34	42.3	36.8	32.5
35 to 44	20.3	27.2	34.7
45 to 54	16.0	18.8	17.6
55 and over	10.2	10.0	10.1
Secondary teachers			
20 to 24	9.0	6.4	3.9
25 to 34	43.8	38.0	32.9
35 to 44	22.6	29.4	36.2
45 to 54	15.7	17.3	17.1
55 and over	8.8	8.9	9.9

SOURCE: NCES (1985b), Table 3.7.

those listed in Table 1 are derived from Current Population Survey data, they provide reasonably reliable estimates of teachers' demographic characteristics, which can be updated yearly at minimal expense to monitor changes in the demographic characteristics of the teacher workforce; but far more detailed data are required to pinpoint changes by type of school, teaching field, and location.

Other survey statistics suggest that there has been a marked shift in the experience levels of teachers during the last 10 years. (See Table 3.) The statistics for the years up to 1981, which are drawn from National Education Association (NEA) surveys, show a sharp drop between 1976 and 1981 in the proportion of public school teachers with fewer than five years of experience and a sizable increase in the proportion of teachers with over 20 years of experience. The analogous statistics for 1983, which come from the NEA National Teacher Opinion Poll, may indicate a continuation of the trend, but some of the apparent change between 1981 and 1983 may reflect differences in the surveys themselves. The rapid increase in the proportion of teachers with 20 or more years of experience has not been accompanied by an increase of the same order of magnitude in the proportion of teachers of age 45 or over (from 25.4 percent in 1976–77 to 27.4 percent in 1983–84). Instead, the largest increase has been in the proportion of mid-career teachers, age 35 to 44. The clustering of teachers in middle to senior career levels suggests that teacher retirement may become a far more significant source of teacher turnover than it has been in the past.

Table 3

PERCENTAGE DISTRIBUTION OF TEACHERS BY EXPERIENCE, PUBLIC ELEMENTARY AND SECONDARY SCHOOLS, 1961–83

Years Experience	1961	1966	1971	1976	1981	1983
1 to 2	14.3	18.4	16.8	11.3	5.3	3.2
3 to 4	13.2	14.4	15.6	16.0	8.2	5.1
5 to 9	19.4	21.7	24.0	28.9	26.2	22.4
10 to 14	15.1	14.2	15.6	17.3	23.0	25.7
15 to 19	10.4	9.8	9.7	12.5	15.4	17.4
20 or more	27.6	21.4	18.3	14.1	21.9	26.1
Mean years of experience	13	12	11	10	13	15
Median years of experience	11	8	8	8	12	13

SOURCE: NCES (1985b), Table 3.5.

Understanding changes in the composition of the teacher workforce during the last decade requires moving back in time to understand the factors that shaped the current workforce. Many of today's teachers entered the profession during the period of rapid expansion of the teaching force to accommodate the baby boom. For elementary schools this expansion began in the mid 1950s and lasted through the early 1970s. This has been followed by a decline in elementary school enrollments in most areas during the 1970s and early 1980s, especially in large metropolitan areas in the East and Midwest (NCES, 1985b, p. 24). The aftereffect has been a concentration in some areas of a disproportionate number of teachers who will be approaching retirement within the next 15 years. This narrowing in the age distribution of current teachers was exacerbated by staff reductions in force in some areas during the 1970s and early 1980s, which fell disproportionately on younger teachers.

Although the teaching force has become more experienced over time, teacher surveys indicate a relative stability over time in other characteristics. Most public teachers (over 80 percent) are first-generation college graduates, and about 60 percent come from working class families. These proportions have remained fairly stable since 1961 (NEA, 1981). About 30 percent of public school teachers teach in the community where they grew up; another 50 percent teach in a community where they spent much of their adult life (NEA, 1981).

TEACHER PREPARATION

The greater experience level of the teaching force has been reflected in higher levels of educational attainment, as most teachers have continued to gain education throughout their years in teaching. According to the most recent national data, 52.3 percent of all public school teachers held at least a master's degree in 1983. This represents a dramatic increase from only 38 percent in 1976 and 23 percent in 1966. Although 15 percent of teachers had less than a bachelor's degree in 1961, by 1983 the proportion was only 0.4 percent (NCES, 1985b, p. 154).

Although the overall educational attainment of the current teaching force has increased, some evidence suggests that the academic ability of recent entrants to teaching has declined. A study commissioned by the Council of Chief State School Officers noted that education majors have usually ranked below other college majors on Scholastic Aptitude Test (SAT) scores, but that the gap widened between 1972 and 1980, when the average SAT verbal scores of education majors declined by 29

points and their SAT mathematics scores fell by 31 points. During the same period, the average SAT scores of the general student population fell by approximately 20 points. In 1980 the SAT verbal scores of education majors were 35 points below the average for all U.S. college students and their SAT mathematics scores were 48 points below the national average (Council of Chief State School Officers, 1984). A 1984 study of education majors at 17 colleges in the South found that the SAT scores of education majors averaged 70 points below those of students in the arts and sciences divisions (Galambos, 1985, p. 34). Of course, education majors are not the only college graduates who enter teaching; of the recent college graduates who entered teaching in 1985, about 30 percent majored in fields other than education.[1] However, other evidence (Vance and Schlechty, 1982) indicates that, during the 1970s, both education majors and other entrants to teaching were disproportionately drawn from the lowest groups of SAT-scorers, and that the most academically able were least likely to enter teaching if they majored in education or to stay in teaching if they entered.

Test scores are not clear evidence of quality or lack of quality. What we mean by teacher quality may be more influenced by what teacher candidates learn after they enter college than by the entrance examination scores that they presented at matriculation. Therefore, concern about teacher candidate SAT scores is increasingly being replaced by attention to the content of the education that they receive in college.

A recent study conducted by the Southern Regional Education Board has questioned the academic content of college coursework taken by those preparing to enter teaching (Galambos, 1985). That study also found that teacher candidates (education majors) take fewer college-level courses in English, mathematics, physical sciences, economics, history, political science, sociology, foreign languages, and philosophy than students who major in arts and sciences. The study found that teacher candidates take only 38 percent of their total college hours in general education subjects (mathematics, science, social science, and humanities) compared to 45 percent for other college students, and that the subject area majors undertaken by secondary teacher candidates averaged fewer total credit hours and fewer credit hours in upper-level coursework than was the case for other subject majors.

These findings regarding trends in the academic ability and college preparation of recent teacher candidates suggest that there is reason for concern about the newer cohorts of teacher entrants and that more detailed information is needed about teachers' academic backgrounds.

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[1]CES, Recent College Graduates Survey, 1985, unpublished tabulations.

TEACHER CERTIFICATION AND TRAINING

To upgrade the qualifications and quality of the teacher workforce, most states have enacted changes in teacher certification and training policies in the past few years (AACTE, 1985). These changes have included establishment of teacher competency testing as a part of the training and certification process in 46 states, additions to the course requirements for students in teacher preparation curricula, and establishment of minimum academic achievement standards for admission to teacher preparation programs (Darling-Hammond and Berry, 1988).

In support of efforts to improve the qualifications of the teacher workforce, 70 percent of teacher education programs now have minimum grade requirements that must be met before a student is admitted to the training program. Half also require that students pass a proficiency test before completing the program—a number that has doubled since 1980 (Holmstrom, 1985).

In some cases the adoption of higher admission standards or of higher academic performance standards for students in teacher training programs has been the initiative of an individual institution. In many instances, however, the adoption of such policies has been mandated by state education authorities as an extension of teacher certification requirements. Seventeen states have prescribed admissions tests for entry into teacher training programs, and 13 states have enacted minimum grade point standards for teacher training program admissions (Goertz, 1985, p. 20).

Most states have also adopted modifications in specific teacher certification requirements. The most notable of these have been increases in required hours of college credit in a subject area for secondary certification, evaluation of classroom performance for beginning teacher certification, and continuing education requirements for recertification. However, state requirements for teacher certification—and the nature of recent changes—vary so substantially that a teacher certified in one state is unlikely to meet the certification requirements in another.

The complexity and confusing variety of rules applying to teacher certification may contribute to local imbalances between teacher supply and demand. To reenter teaching in a new state of residence, former teachers often must undertake additional coursework. Also, they often lose credit for prior experience and must enter the new state or local compensation system at or near the bottom of the salary schedule. Many teachers also lose their state retirement benefits when they leave the state. All of these factors discourage former teachers from reentering teaching after an interstate move or from moving to another state where their services might be needed.

TEACHER TURNOVER

As noted above, teacher experience and education increased during the period from the late 1960s to the early 1980s, as the veteran teaching force became more stable. There are several indicators of increased stability over this 15-year period, including fewer breaks in service for teachers, decreased mobility, and evidence of lower turnover.

About 70 percent of public school teachers in 1981 had had no breaks in their continuous teaching service, up from about 62 percent in 1966. Although more female teachers had breaks in service than men (37 percent versus 16 percent), primarily for childrearing reasons, the proportion of women teachers taking leaves from teaching declined steadily from 1966 to 1981 (NEA, 1981). This trend signifies a change in occupational exit and reentry patterns that has implications for data-gathering efforts. The traditional view that teaching is an occupation in which women make frequent exits for childrearing from which they then return is less true than it once was.

Teacher mobility also appears to have declined over the years from 1966 to 1981; only 2 percent of public school teachers taught in another school system in the previous year, and an equal number were planning to do so in the following year, as compared to 6–7 percent 15 years earlier (Table 4). The decline in mobility may have been linked to the decrease in new teacher demand during the 1970s, as mobility is easier when many positions need to be filled. However, in 1981, for the first time, a larger percentage of teachers was teaching during the previous school year (94.5 percent) than planned to teach the following year (89.1 percent) (NEA, 1981).

Other data suggest that between about 1969 and 1983 teacher turnover continued to decline (Grissmer and Kirby, 1987). In four states that publish time series data—Illinois, Michigan, New York, and Utah—turnover rates (including attrition from teaching and mobility out of state) showed a downward trend from the 1960s and 1970s to the 1980s. Here, "turnover" includes all teachers who taught in the state during one year and not in the following year but excludes within-state mobility (i.e., teacher moves from one district to another within the state). The definition includes both temporary and permanent (and voluntary/involuntary) attrition from teaching within the state and individuals moving to another state who may or may not teach.

One explanation for these trends is that, during the 1960s, there was a strong demand for new teachers, whose turnover rates run 5 to 10 times higher than for mid-career teachers. As the demand for new teachers declined during the 1970s and 1980s, the teaching force became predominantly mid-career and hence more stable.

Table 4

PERCENTAGE DISTRIBUTION OF TEACHERS' ACTIVITIES DURING THE PREVIOUS AND FOLLOWING YEARS, 1966-81

Activity	1966		1971		1976		1981	
	Last Year	Next Year	Last Year	Next Year	Last Year	Next Year	Last Year	Next Year
Full-time teaching	87.4	91.3	88.2	89.4	90.8	91.2	94.5	89.1
Same school system	80.5	85.6	83.9	84.6	88.3	87.3	92.5	87.3
Another school system	6.9	5.7	4.3	4.8	2.5	3.9	2.2	1.8
Attending college or university full time	8.5	1.7	7.0	1.4	4.5	1.3	1.0	0.9
Military service	0.2	0.0	0.3	0.0	0.2	0.0	0.0	0.1
Working in nonteaching position	1.1	1.5	1.4	2.1	1.2	1.9	0.9	2.4
Homemaking/childrearing	1.6	2.9	2.0	3.2	1.7	2.1	1.2	2.4
Unemployed and seeking work	0.2	0.4	0.3	0.3	0.4	1.1	0.2	1.1
Retired	0.0	1.5	0.1	2.2	0.0	1.5	0.1	1.7
Other	0.9	0.8	0.8	1.3	1.4	0.9	2.1	2.3

SOURCE: NEA (1981).

However, this demographic shift can explain only a portion of the change in overall turnover rates. In New York, turnover rates for each age group declined from 1967 to 1983 (see Table 5). These data show the usual higher turnover for younger age groups for each time period. However, within each age group, turnover declined over time, except for retirement-eligible groups where it increased over time. These trends point to structural factors within the teaching profession or the teacher labor market, which resulted, for a time, in higher long-term retention rates for teachers before retirement.

TEACHING AS AN OCCUPATION

Trends in experience levels, continuity of service, mobility, attrition, and educational attainment of teachers may suggest that a greater proportion of current teachers are committed to teaching as a career than was true in the past. These changes can occur because of demographic

Table 5

TURNOVER RATES BY AGE, NEW YORK STATE PUBLIC SCHOOLS, 1967–84

Age	1967–68	1974–75	1981–82	1983–84
< 35	21.8	15.8	11.3	11.4
35-39	10.1	7.4	6.1	6.4
40-44	8.7	6.5	5.4	5.7
45-49	7.9	6.5	5.2	5.3
50-54	8.7	8.4	7.8	7.9
55-59	11.3	13.6	14.6	16.5
60+	24.0	30.2	27.1	29.8

SOURCE: Unpublished data, New York State Education Department, Information Center on Education, July 1983.

shifts in the teaching force, changes in the overall labor market for college graduates, and structural changes in the occupation.

Life Cycle Career Patterns for Teachers

Patterns of participation in the teaching profession tend to follow a general life cycle theory of participation and attrition from occupations. As Table 5 shows, turnover rates, as a function of age, follow a U-shaped pattern. The rates are high for individuals early in their career, low during the mid-career phase, and high again once retirement eligibility is achieved.

High turnover during the first five years of teaching can be explained by several factors. Individuals may leave because of a mismatch between original expectations and actual experience as teachers, or because of attractive outside opportunities. Incoming teachers often get the least desirable assignments, spend more time preparing for classes, and lack an established support network. They are also often adjusting to a first job and the experience of living autonomously. Conflicts may arise between the demands of holding a job and family formation that usually takes place at this time. For a number of reasons, transfers to other occupations are generally easier at this early phase of the career, as salaries and debt obligations are lower, and occupation- and location-specific human capital (such as retirement vesting) is not high.

Teachers who reach the mid-career phase (defined roughly as 10–25 years of teaching experience) have a much lower turnover rate. "Self-selection" is a partial explanation—continuing teachers have a higher "taste" for teaching. If they did not leave earlier in their careers, they are less likely to leave later. Another explanation is that, in mid-career, it is harder for those who lack transferable job skills to find alternative jobs with matching salaries. They are also less mobile because of family responsibilities and debt obligations, and they are less likely to have their careers interrupted by family formation and childrearing.

Late career turnover depends on the structure of the relevant retirement system. Eligibility for retirement ordinarily depends on two factors—age and years of experience. A typical system might require attaining age 55 with at least 20 years of teaching in the system. Staying beyond these minimum requirements—typically to age 62 or 65—enhances the retirement pension. Turnover begins to increase when teachers attain the minimum requirements for eligibility.

Labor Market Conditions and Teaching

A major factor influencing the teaching force between the late 1960s and the early 1980s was the decline in student enrollments producing lower demand for new teachers at a time when there was also an oversupply of college graduates seeking work in other sectors of the economy. Relatively steady increases in the unemployment rate from the 1960s through 1983, especially among persons with four or more years of college, and steady increases in the proportion of women in the labor force, produced substantial competition among college graduates for jobs. The oversupply of prospective teachers in the 1970s who could not easily find alternative employment resulted in salary levels that did not keep pace with increases in other fields. Consequently, school administrators could be more selective in teacher hiring. The recessions in the 1980s (January-July, 1980, and July, 1981-November 1982) and their aftermath of unusually high unemployment for college graduates in 1982–83 undoubtedly influenced the observed decline in teacher turnover rates during the early part of this decade. Virtually all of these factors, however, can be expected to change in the years ahead.

The characteristics of the "average" individual entering the profession changes when demand for new teachers is high rather than low. Other things equal, a high demand for new teachers—such as existed in the 1960s—encourages individuals at the margin to enter the profession who have less "taste" or commitment for teaching. Individuals who

chose teaching in the baby boom era were more easily attracted into teaching because of the ready availability of jobs and may have made less informed—and more easily reversed—decisions about the suitability of teaching for them.

At the same time, school districts are probably less discriminating and less selective in hiring during times of high new teacher demand. Greater selectivity can mean hiring more experienced and able teachers rather than new college graduates, or choosing individuals displaying characteristics associated with longevity and commitment to the profession. As demand for new teachers grows, school districts must reach deeper into the pool of applicants, which usually means accepting teachers with less desirable characteristics.

There has been an additional change in the pool of entering teachers in recent years which might have led to lower turnover: More entering teachers have had either previous teaching experience or previous work experience outside the profession. Both of these characteristics lead to lower turnover. Two conditions created this pool of more experienced individuals. As the demand for new teachers declined in the 1970s, there was a surplus of education majors unable to get teaching jobs. Some of these individuals took other jobs and waited to enter teaching until opportunities became available. There were also reductions in force in some areas, creating a pool of experienced teachers who would later reenter teaching. The existence of these pools in the early 1980s meant that school districts were less dependent on the new college graduate market.

These trends are evident in Table 4. From 1966 to 1981 the proportion of new entrants (those who were not teaching in the previous year) declined from 13 percent to 5 percent of the total teaching force. Meanwhile, the proportion of new entrants who had been attending college the previous year declined from 67 percent (or 8.5 percent of the total teaching force) in 1966 to 18 percent (or 1 percent of the total teaching force) in 1981. In 1981, 16 percent of new entrants had been working in nonteaching positions during the previous year; 22 percent had been homemakers; 6 percent had been unemployed or retired; and the remainder were engaged in other pursuits.

It thus seems likely that the new teachers hired in the late 1970s and early 1980s were more highly selected and more experienced than those selected in the 1960s and early 1970s. This is consistent with evidence suggesting that districts' ability to be selective in hiring teachers depends on demand conditions (Murnane and Phillips, 1981). This kind of selectivity would primarily affect early turnover of teachers.

Another factor leading to higher turnover in times of growth in the teaching force is the relative ease of movement among teaching jobs.

Decisions to move between schools, districts, and states are less risky when jobs are readily available than they are in tighter labor markets. It is also easier to stop teaching to return to school, raise children, or try another job knowing that teaching jobs will be available if one decides to return. The teacher reductions in force that occurred in the late 1970s and 1980s reinforced the risk associated with leaving teaching jobs.

Real increases in teacher pay, benefits, and working conditions relative to closely competing occupations should result in increased teacher retention. Teachers' salaries increased to some extent during the 1960s, but subsequent declines were steep, and more recent increases have not recouped the ground lost during the 1970s (see Table 6). Increases since 1981 have not yet returned average teacher salaries to their real dollar level of 1971, and when adjusted for experience, the gap is still wider. Salaries do not seem to be the major reason for increased stability in the teaching force, although benefits and working conditions may have improved. The change in one key working condition—class size—can be documented. Class sizes have declined by 15 to 20 percent from the 1960s to the 1980s.

Changes in teacher retirement systems can also influence teacher turnover. Higher benefit levels may reduce turnover among mid-career teachers by providing greater incentives to stay in the profession. Policies regarding early retirement can also affect age-specific turnover rates by influencing the timing of retirement.

Table 6

AVERAGE TEACHER SALARIES, 1956–86

Year	Current Dollars	1986 Dollars	Adjusted for Teacher Experience (1986 Dollars)
1956	4,055	16,564	—
1961	5,275	19,575	21,410
1966	6,485	22,184	24,818
1971	9,269	25,408	29,060
1976	12,591	24,554	28,698
1981	17,364	21,203	23,085
1986	25,240	25,240	25,240

SOURCE: AFT (1986), Tables II-1 and II-2.

Alternative Career Opportunities

A very important labor market development affecting teacher supply and demand is the growth in career opportunities available to women and minorities. Traditionally, teaching has been a leading career choice of female college graduates, but academically talented women are increasingly pursuing other occupations. Between 1970 and 1981, the proportion of women receiving bachelor's degrees in education decreased by more than half, from 36 percent to 17 percent. During that decade, women's professional options expanded enormously. Women's occupational choices shifted from education, English, and the social sciences to business and commerce and the health professions. The proportion of degrees granted to women also increased tenfold in the biological sciences, computer sciences, engineering, and law. The same pattern is evident for minority students (Darling-Hammond, 1984).

The range of expanded options available to talented women and minorities today means that schools now have to compete with other occupations and industries for talent. This has affected teacher production and may affect the size of the reserve pool as well. The number of college students choosing to teach has declined from over 200,000 annually (or about one-fifth of all college graduates) during the early 1970s to just over 100,000 annually (about 10 percent of college graduates) in the mid-1980s. In addition, those leaving teaching may be less likely to return to the profession. As the number of college-age students declines in coming years, and competition for college graduates increases from other sectors of the labor market, the earlier traditional "pools" of teachers may become harder to tap.

Changes in women's initial occupational choices are related to changes in their labor force participation as well. Throughout this century, each succeeding cohort of women has had higher labor force participation rates, remaining out of the labor force for less time during the childbearing period and returning to work at higher rates thereafter. The overall labor force participation rate for women is now over 50 percent; for those under 30, it is closer to 70 percent, including married women and women with children (Waite, 1981). Traditionally, women entered teaching both because they had few other professional opportunities and because its work schedule was more consistent with family responsibilities than many other occupations. Although the compatibility of teaching with family responsibilities is probably still an attraction for many women, as women's labor force patterns increasingly approximate those of men's, many professional women can be expected to seek the same payoffs from their labor force activity

that men seek, such as promotion opportunities and professionally competitive salaries.

As the teaching force is still predominantly female and the job is structured in many ways based on the premise that this will continue to be so, these changes in the occupational and labor force decisions of women have important implications for teaching. On the one hand, more career-oriented younger women may be less willing to trade off low salaries and flat career profiles for the flexibility that teaching allows to accommodate childrearing. On the other hand, some women who left teaching to raise children (many now in their late 30s to mid-40s) may, in seeking reentry to the labor force, consider teaching as a job option, thus expanding the potential pool of teachers. These women, some of whom prepared to teach years ago, are part of the reserve pool for teaching—an increasingly important source of supply—although reentry into teaching may be inhibited in some areas by recent changes in certification standards. Data-collection efforts should seek to identify the types of individuals attracted to teaching under different certification and career structure conditions.

In addition to these labor force changes affecting the primary pool of traditional teachers, a number of recent policy changes are likely to influence the nature of teaching as a career, and hence the types of individuals who will enter teaching and the amount of time they will stay.

CHANGES IN THE TEACHING OCCUPATION

The recognition of problems facing the teaching profession has led to a series of policy initiatives and changes by state legislatures, governors, state and local school boards, and colleges involved in teacher training. These changes have had the multiple, and sometimes conflicting, aims of

- Enhancing teacher recruitment;
- Improving the quality of the teacher workforce in terms of academic preparation and qualifications; and
- Creating greater incentives for improved educational performance in the schools.

Teacher Compensation

Perhaps more than any other single element affecting teaching, teacher pay has been identified as a critical policy variable by public officials wanting to improve teaching conditions. In the past several years, teacher salaries have increased in every state (Feistritzer, 1985). With much attention being given to beginning teacher salaries to attract new entrants, across-the-board salary increases have also been enacted in some states.

In 15 states, laws have been enacted creating career ladder or merit pay systems that supplement the beginning salary or across-the-board salary increases (AACTE, 1985). These plans present the prospect of future salary growth for teachers who satisfy specified criteria of merit. In addition to raising earnings, it is presumed that career ladder plans will make teaching more attractive to capable individuals who expect to be rewarded for their achievements. The ultimate outcomes of these plans have yet to be determined, though, as some have met with substantial opposition and others have been tabled for lack of funding (Darling-Hammond and Berry, 1988).

Recruitment Initiatives

Besides increasing teacher salaries, a number of other innovations have been adopted to recruit new teachers. Almost every state has recently adopted some form of aid for college students who prepare to enter teaching. These programs range from scholarships for academic achievement to forgivable student loans for those who complete a minimum period of teaching service (AACTE, 1985). In some states these programs are directed only toward candidates for teaching positions in areas of critical need such as mathematics and science. Increasingly, though, the trend is toward incentives for all teaching fields. A recent report cited evidence that 25 percent of all teacher preparation programs in the nation now offer some form of scholarship or loan program to recruit high academic achievers into teaching (Holmstrom, 1985).

Another innovation to enhance teacher recruitment has been the adoption of alternative teacher certification routes. These alternatives vary from the traditional emergency certificates offered in some states to experimental programs of provisional certification and in-service training for graduates of liberal arts programs who have not completed traditional teacher training curricula. Also included under this heading are recent changes in some states that allow teachers certified in one area to more easily acquire certification in another teaching area in

which the school has a critical need. Over half of the states now have some or all of these alternative certification routes available (AACTE, 1985). These initiatives, however, operate in tension with simultaneous state moves to increase regular certification requirements.

Changes in Working Conditions and Status

Recent discussions of the problems facing the teaching profession have suggested that the solutions to the lessened attractiveness of teaching may need to go deeper than pay raises and certification changes. Large numbers of teachers are dissatisfied with the working conditions and social status of teaching. Between 1966 and 1981 the proportion of teachers saying they would not choose teaching as a career if they had it to do over again increased from under 10 percent to nearly 40 percent (Darling-Hammond, 1984). Many teachers who now regret their career decisions may discourage their own students from considering teaching as a career (Berry, 1985).

The causes of alienation among teachers may be traced to a number of factors including working conditions, administrative patterns, salary policies, and public attitudes. Working conditions that have been identified as sources of teacher dissatisfaction include crowded classrooms, inadequate preparation time, and lack of time and energy for teaching because of the burden of clerical, custodial, and disciplinary duties. Teachers have difficulty perceiving themselves as valued, competent professionals when their work environments lack the kind of clerical support and facilities available to other professionals.

Administrative patterns have also been cited as sources of disaffection. Increased centralization of decisionmaking in many school systems tends to strip teachers of decisionmaking authority and the ability to be creative and innovative in their teaching. Lack of control over the structure and content of their work reduces the motivation for performance.

Salary policies are important influences on teacher morale in two ways: First, the general inadequacy of teacher salary levels can be interpreted as a measure of our society's true regard for the value of teaching and of teachers. This is to be expected in a society that often relates social status and prestige to economic status. Second, the standardized nature of most teacher pay scales—in conjunction with a flat career structure—provides little motivation or reward for outstanding performance. Teachers' social status has also declined as the general population has become more educated and as dissatisfaction with school performance has increased.

Efforts to improve teacher status and working conditions include a variety of teacher recognition programs, increased support for teacher aides and clerical assistance, relief from nonteaching duties, and reallocations of decisionmaking authority to give voice to teachers' views.

Over time, the development of policy reforms that may change the occupational structure of teaching will interact with labor market factors to shape the supply and demand for teachers. These factors provide the backdrop for modeling teacher supply and demand and for examining the assumptions that underlie projections of supply and demand. We turn to these issues in the following sections of this report.

III. TEACHER SUPPLY

Individuals are attracted to, are trained for, enter, and reenter the teaching profession along many different paths. Figure 1 provides a schematic representation of the flows of teachers in and out of the teaching force. It can be thought of as applying to the national precollege teaching force or to any segment of that force, such as the subpopulation of science teachers within a particular region or state.

COMPONENTS OF TEACHER SUPPLY

The stock of teachers at the beginning of any school year (indicated by the box at the bottom of the figure) consists of four components of teacher supply: (1) new entrants into the system; (2) former teachers who are reentering the system; (3) holdover teachers from the preceding year; and (4) immigrants, that is, individuals who have transferred into the system from other teaching posts. Depending on the stock of teachers under consideration, the "immigrants" category may be small, as it is in the case of the national precollege teaching force. However, if it consists, say, of science teachers in Colorado secondary schools, the immigrants category would include nonscience and nonsecondary teachers from Colorado who become secondary school science teachers, as well as teachers transferring from other states, and this category could constitute a sizable segment of the current stock.

Examining the characteristics of current teachers is a necessary first step in profiling the nation's teaching force in a manner that is useful for assessing future supply. At a minimum, data on ages, qualifications, and assignments are needed, as well as information on dates of entry into teaching and sources of teacher supply.

In addition to information on current teachers, assessments of teacher supply require data on two groups of prospective teachers: students in the teacher training "pipeline" who can be expected to enter teaching shortly, and the "reserve pool" of individuals who are qualified to teach but are not currently teaching.

The pool sizes and the likelihoods of transitions into the teaching force among individual members of the prospective teacher pipeline and reserve pool constitute the "supply side" of the teacher labor market. The fact that the populations of current and prospective teachers are in a continual state of flux suggests that we should think of teacher supply as a dynamic process that depends on numbers of

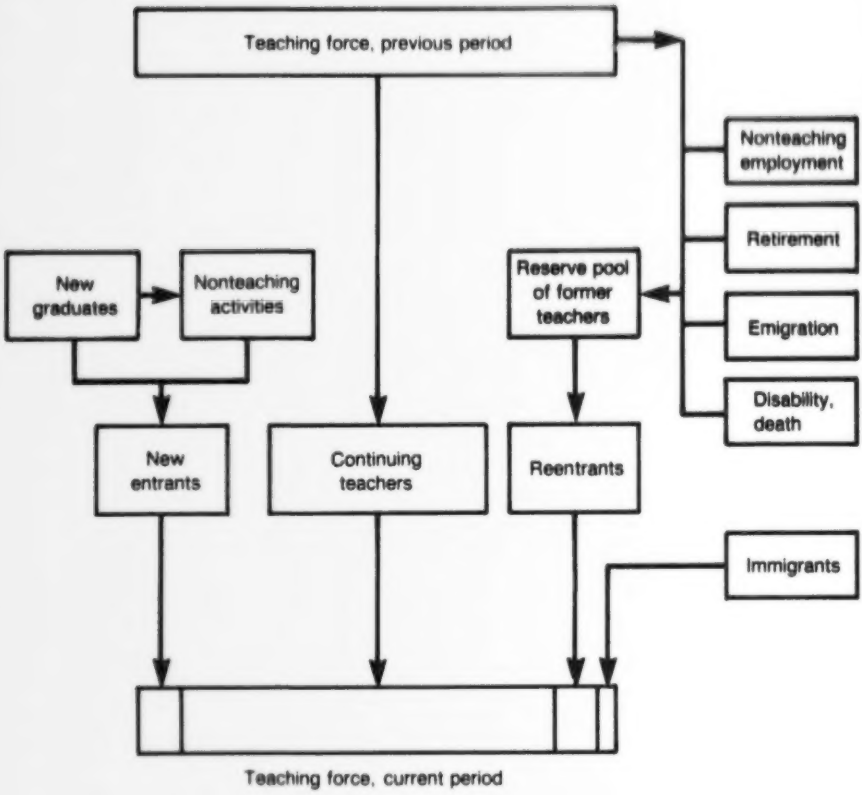

Fig. 1—Schematic representation of flows in the teaching force

potential teachers in each of several populations and on numerous factors that affect the career choices of prospective teachers. Supply projections, instead of being expressed as single numbers encompassing all sources of supply, can be viewed as conditional estimates that depend on the numbers of prospective teachers in the populations of interest as well as factors, such as certification rules and salary levels, that affect entry rates into the teaching force.

None of these estimates is simple to derive, and currently available data sources are inadequate for most of them. To complicate matters further, local or regional supply estimates must take account of in- and out-migration from the labor market area, and field-specific estimates must take account of substitution possibilities among teachers in different teaching areas. These "immigrant" sources of supply take several forms and are of varying importance in different types of schools, districts, and teaching fields. At the school level, for example, a vacancy for a mathematics teacher may be filled by recruiting a mathematics teacher from another school, by assigning other teachers to cover the requisite courses, or by resorting to combinations of part-time, substitute, or itinerant teachers for some or all of the classes that are to be taught.

When shortages or budgetary problems occur, other staffing and scheduling changes may be used to alleviate unfilled or partially filled vacancies. These include reassigning some courses to other teachers who do not have a full teaching load, changing course offerings, and adjusting class sizes or teaching loads. These responses artificially alter the demand for teachers of certain types and affect the character of teacher supply in ways that can be inferred only from examinations of hiring and assignment practices.

State and district personnel policies regarding certification, compensation, hiring, and retention mediate between the demand for teachers and the supply of potential teachers to shape the teaching force at any given time. These policies, along with labor market conditions and factors affecting the relative attractiveness of teaching, influence which prospective teachers decide to teach and which are selected to teach. The policies themselves do not remain immune from supply and demand forces: In times of high demand or relatively short supply, the policies often change to allow most positions to be filled (e.g., increases in salary, relaxation of certification requirements, and changes in hiring practices).

Because of this interplay between teacher supply and the quality of teaching candidates, assessments of supply must take into account the qualifications of current and potential teachers. The quality distribution in each component of the supply pool is critical, because sharp changes in demand may produce greater adjustments in "quality" than in "quantity." Indicators of the qualifications of current and prospective teachers are needed to assess current supply under differing quality standards and to gauge future supply based on assumptions about changes in those standards.

To estimate the effects of various policy alternatives on overall supply, we need to know more about the sources of entry into teaching,

the size and character of the reserve teaching pool, the conditions under which its members will offer their services to education, the determinants of teacher turnover, and the degree to which certain teacher attributes or skills are interchangeable when shortages exist in some teaching fields while surpluses exist in others.

SUPPLY OF NEW TEACHERS

In the past, the primary source of new teachers has consisted of recent bachelor's or master's degree recipients who completed an approved program or accumulated the requisite number and distribution of college courses for initial certification. The second major component includes college graduates who are not qualified to teach upon graduation but who enter a postbaccalaureate program that leads to qualification; this may be a year of graduate education or a sequence of undergraduate courses, depending on state requirements. Another potential source of future teachers includes bachelor's degree recipients not qualified to teach who engage in nonteaching activities either in or out of the labor force. Some individuals in this group subsequently enter postbaccalaureate teacher qualification programs; upon completion, they join the ranks of persons qualified to teach.

Many college graduates who are qualified to teach take nonteaching jobs or remain unemployed for a year or more before they enter teaching. Others who initially enter nonteaching occupations or pursue homemaking careers may seek teaching credentials several years after leaving college. Although late entrants from the nonteaching sector may not have constituted a large proportion of new teachers in the past, college graduates in nonteaching occupations and homemaking constitute a relatively large population of individuals who may consider a career in teaching at some time in the future, given appropriate inducements or adverse employment experiences in other fields.

The component of teacher supply that has received the most attention in previous analyses is the supply of beginning teachers coming out of the teacher pipeline, especially those college graduates who are qualified to teach at the time of graduation. Projections of the future supply of teachers can be made by either estimating the average probabilities of entry into teaching for homogeneous subgroups of prospective teachers or by adding up individual propensities for all individuals in the pipeline; thus, it is important to know how these propensities vary over time and across subpopulations of the pipeline.

In the absence of detailed data, it is commonly assumed in making projections that the teacher production rate is a constant share of the

college student population. In fact between 1971 and 1981, the proportion of college students majoring in education declined by nearly half—from 21 percent to 11.6 percent. Thus, projections of teacher supply must allow for trends in the occupational decisionmaking of students.

To gauge college graduates' propensities to enter teaching, we need to know what proportion of students receiving bachelor's degrees in education actually plan to teach, and how many do so. We also need to know what proportion of students receiving degrees in other fields enter teaching. Prior CES surveys of recent college graduates have obtained such data; however, they do not provide information about the degree to which failure to enter teaching is due to inability to find jobs or to changes in occupational plans. Such information could be derived from follow-up surveys of recent college graduates.

The proportion of teacher education graduates who enter teaching varies substantially over time and across teaching fields. In 1976–77, CES estimated that the proportion of newly qualified graduates seeking teaching positions was 77 percent, with only 60 percent ultimately accepting teaching positions. In 1981, the estimate of those seeking full-time positions was 85 percent, with 64 percent ultimately accepting such positions. Differences among teaching fields are also substantial. In 1981, for example, only 30 percent of prospective health teachers accepted full-time teaching jobs as compared to 75 percent of prospective special education teachers (NCES, 1983).

We also need to know how many masters' degrees are awarded to persons preparing to teach and how many to current teachers. In the past, most masters' degrees in education were awarded to current teachers, but this may change as states open up alternative routes to certification for liberal arts graduates and as some teacher education programs move to a five-year model. Furthermore, at least half the states permit the hiring of teachers who have bypassed many state certification requirements (Raizen, 1986). Entrance into teaching on the part of those who have not majored in undergraduate teacher education programs can be tracked by obtaining data on the educational and training backgrounds of members of the teaching force.

If we are to understand the factors influencing the supply of new teachers, the relationship between educational and occupational plans and actions must be examined at several points in the teacher training pipeline: at college entry, choice of major, college exit, initial occupational choice, and later occupational decisions. Longitudinal survey data tracking college students are the most suitable vehicle for assessing career decisions, when sample sizes for the populations of teacher candidates are large enough.

SUPPLY OF CONTINUING TEACHERS

The supply of continuing teachers in any year is the number of teachers in the previous year less teacher turnover. Insofar as the national teaching force is concerned, continuing teachers constitute the largest portion of teacher supply and, as will be seen in Sec. VI, teacher turnover is the dominant component of the demand for new teachers. Despite its importance, CES has not collected national data on teacher turnover for nearly 20 years.

CES projections incorporate an assumption that teacher turnover rates are constant over time, but there are reasons to believe that turnover rates are not static. First, the age composition of the teaching force changes over time; hence, the proportion of the force nearing retirement also changes, as does the proportion of beginning teachers, who experience high turnover rates. Second, labor market conditions influence turnover; when teaching positions are scarce, temporary exits may be fewer because of expected difficulty in reentering; when other opportunities are plentiful, career changes are more likely. Third, school policies may influence teacher turnover. Incentives for early retirement, for example, became widespread in school districts during the 1970s, when declining enrollments required reductions in force. Current policy initiatives, such as internships for beginning teachers and merit pay or career ladders for veterans, along with other changes in salary levels, are intended to reduce turnover. Thus, we should expect turnover to vary as the composition of the teaching force changes, as policies affecting teachers evolve, and as employment opportunities outside of teaching change.

Analyses of turnover rates and patterns are permitted by data collected from school administrators on the numbers of teachers leaving and their reasons for leaving. This approach to collecting turnover data was used in the NCES 1969 School Staffing Survey. Such data allow calculation of turnover rates and examination of turnover patterns from schools or districts of different types but do not allow exploration of turnover patterns by teacher type (e.g., age, teaching field, qualifications, sex, and race).

To support analyses of individual turnover behavior, the ideal data base would consist of a large, nationally representative longitudinal study of teachers to examine the characteristics of both leavers and nonleavers, their schools, school policies, and the myriad economic, family, and community factors that affect individual employment decisions. Unfortunately, that would be an extremely costly enterprise. Less ambitious options for gathering district, school, and individual data are described in Secs. VII and VIII. At a minimum, analyses of

turnover behavior require data that will allow examination of the contributions to teacher turnover of both life cycle factors (such as age, leaves for childrearing, and retirement) and organizational factors (such as compensation and working conditions).

THE RESERVE POOL

Another large group of prospective teachers is the reserve pool of individuals who are qualified to teach but who are not currently teaching, either because they, perhaps temporarily, left teaching to raise families or pursue more education, or because they entered other occupations. Assessing the supply potential of the reserve pool depends on estimating how many of these individuals would consider reentering teaching under various conditions as well as the annual rates of entry into and exit from the pool.

This source of teacher supply is difficult to assess but may become increasingly important if the number of new college graduates entering teaching continues to shrink. Some states estimate that they are filling many or most of their current vacancies from the reserve pool (Raizen, 1986). However, we do not know how "deep" the pool is or what the characteristics of its members are. Estimating the flows into and out of the reserve pool of former teachers is difficult, partly because this population is not restricted to particular cohorts and partly because former teachers constitute a very large, heterogeneous population that is not readily circumscribed.

At the national level, there is a critical gap in information on the size of the reserve pool of former teachers. The Rattner et al. (1971) approach—cumulating new graduates eligible to teach over time, adjusting for mortality, and subtracting the stock of teachers currently employed in other sectors of education—provides a gross measure of the size of the total reserve pool. However, this approach can tell us nothing about the relative propensities of individuals in the pool to seek teaching positions.

The reserve pool may be thought of as a series of concentric rings, each of which represents a group of individuals not now teaching who, under some circumstances, might enter teaching. (See Fig. 2.) As the rings radiate from the center, the likelihood of entry to teaching for individuals in each ring decreases. The conditions under which members of different rings would enter teaching vary. The rings may further be divided into sectors, by age, field, sex, or current activities (e.g., part-time or full-time job, homemaking, and education). This notion of the reserve pool allows us to think about the prospective

supply of teachers in a more systematic way and to conceptualize flows into teaching of individuals with many different backgrounds and current circumstances. The examples shown in Fig. 2, though, are hypothetical because we do not currently have much information on the propensities of individuals of different types to seek jobs in teaching—or to consider doing so under varying circumstances.

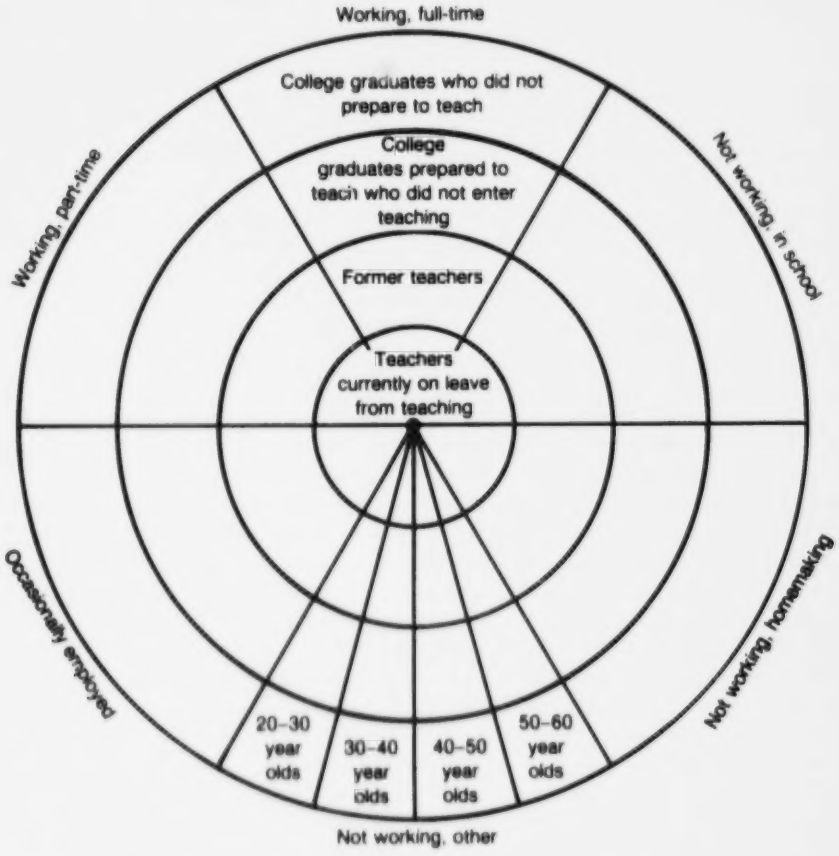

Fig. 2—The teaching reserve pool: an example

There are two approaches to the acquisition of this information. One, the inferential approach, is to develop and fit statistical models of former teachers' employment behavior using either longitudinal data, such as that available from CES's National Longitudinal Survey, or cross-sectional data, such as that obtained from eliciting job histories from recent entrants into the reserve pool or from recent reentrants into teaching. A second approach geared to estimating future flows from the reserve pool is to obtain intentions data through surveys in which "what if . . . " questions are asked. Of course, data obtained in this way provide a questionable basis for inference.

To be most useful, data on teachers who enter and reenter teaching should be combined with data on individuals who do not enter or reenter teaching. Tracking both individuals who teach and those who do not allows statistical analyses to estimate how the probability of entry or reentry depends on individual attributes and the characteristics of the locations in which they live. Such estimates can identify groups of individuals more likely to teach and can suggest specific policies likely to increase the supply of teachers.

Another approach to studying the teacher "reserve pool" is to obtain personal and work histories of teacher entrants and leavers through surveys of current teachers and follow-up surveys of those who leave teaching. These kinds of data permit identifying those portions of the reserve pool from which the annual "takes" are largest and examining the job characteristics associated with entry and exit of particular types of teachers. National data sets such as the Current Population Surveys or the Panel Study of Income Dynamics, combined with the teacher survey data, could be used to examine labor force behavior of particular sectors of the potential reserve pool. Follow-up surveys of teachers who leave teaching would further allow examination of their new activities, their reasons for leaving, and their plans for reentry. If these teachers were followed for some period of time, actual rates of reentry could be computed.

Like other components of teacher supply and demand, the size, composition, and potential availability of the reserve pool varies among locations (and for different fields) depending on the characteristics of the local population (age, education, and employment) and economy, the degree of transiency in the population, and current and past school personnel practices. Districts that laid off teachers in the late 1970s and early 1980s, for example, are still rehiring members of their former teaching staffs. Districts with lenient hiring practices may find it easier to tap the reserve pool than those that apply stringent certification, education, or testing requirements. States and districts with more attractive teaching conditions—higher salaries, better working

conditions, good benefits—and those that can offer full credit on the salary scale for prior teaching experience may tap more competent sectors of the reserve pool.

MONITORING AGGREGATE TEACHER SUPPLY

Although reliable time series for monitoring the sizes and compositions of the pools of prospective teachers are not available, the "takes" from subpopulations of these pools can be estimated using data from surveys in which new and reentering teachers are asked about their previous educational and employment histories. Combining this information with data about teacher qualifications, we could identify the proportions of newly hired teachers who come from teacher programs, from other college majors, from homemaking, and from other employment. If this type of data were collected regularly, we could examine trends in sources of supply by field and location.

When work history data are linked to data on qualifications, we can identify the character of current supply and monitor how changes in certification practices influence sources of teacher supply. These data also allow a retrospective examination of exit and reentry patterns for career teachers, thus illuminating the behavior of those members of the "reserve pool" who have returned to teaching. Retrospective data collected from *current* (nonentering) teachers do not adequately describe the characteristics of past cohorts of entering teachers because of selection effects, nor do they fully describe reserve pool behavior, since those not reentering teaching are not represented. However, such data can provide valid information on exit and reentry patterns and lengths of continuous teaching service for committed career teachers. In conjunction with data about those who leave teaching, these data will help to identify the factors that influence the behavior of former teachers and their propensities to seek teaching positions.

These kinds of data about teachers' career paths allow analyses of the characteristics and entrance/exit patterns for teachers of different types. Overall sources of supply can also be monitored by securing periodic counts of newly hired teachers categorized by their sources of entry into teaching. Both of these types of estimates are important for tracking the sources of teacher supply. Without such knowledge, we have no way of gauging the importance of changes in the pipeline for overall teacher supply, or how various types of incentives or certification changes may influence the size and character of supply.

DISAGGREGATING TEACHER SUPPLY

Despite the implication of a unified national data system for monitoring teacher supply and demand, the educational manpower system is in reality a series of local systems whose boundaries are not well defined and whose interconnections are multitudinous. Similarly, each of the major components of teacher supply can be viewed as being made up of subcomponents corresponding to geographical areas such as states and metropolitan areas. Definitive analyses of teacher supply require area-specific information on the flows of individuals into and out of teaching, interarea mobility within the education sector, and flows between the reserve pool and the education sector. Of course, the labor market for teachers is not solely defined in geographical terms. It has a skill dimension as well. Thus flows between teaching and other professional positions in education, which may or may not be accompanied by a locational move, are also relevant. Similarly, flows between teaching in one subject area at one level and teaching in another and flows from teacher preparation programs in one substantive field to teaching positions in different fields are important.

From a national perspective these complexities might appear to be irrelevant. And they probably are, so long as the surplus (or, at another time, the shortage) is very large. But as the size of an overall imbalance in the market declines, the nature of local and field-specific labor markets becomes increasingly important. It is easily conceivable that balance of supply and demand at the national level can be accompanied by large surpluses and shortages at the local level.

All of these factors, taken in conjunction with national indicators of potential shortage, suggest a level of volatility in teacher supply that makes predictability dependent on understanding changing policy conditions and labor market forces both nationally and in their many permutations at the state and local level. Projections—national, state, or local—are only as accurate as the assumptions on which they are based.

National estimates and projections of teacher supply, demand, and shortage, like national unemployment rates or GNP indicators, can be seen as signals of changes in the teaching force. They are not, in and of themselves, roadmaps to action or predictors of local labor market situations. Though these must be understood at the relevant level of the labor market, such understanding can be greatly enhanced by a structural analysis of overall demographic, economic, and social trends as they are manifested and interact with policies and the structure of the teaching occupation in states and localities. Because of the importance of state policies in defining who can teach and the importance of

district policies in defining the attractions to teaching, we believe it is important to gauge the adequacy of supply by state and district type as well as to examine the sources and quality of supply by school and teacher type. Data requirements for doing so are described further in Sec. VII.

IV. TEACHER DEMAND

Estimating and projecting aggregate teacher demand is less problematic than gauging teacher supply, since the components of demand are, for the most part, readily measurable and since most changes are fairly predictable. However, disaggregating demand in meaningful ways is more difficult, requiring knowledge of school staffing patterns and other factors that influence demand for teachers in different teaching fields, levels, regions, or localities.

Figure 3 shows the components of teacher demand. The figure can be thought of as representing the total teaching force or any segment of that force, such as public elementary special education teachers within a particular region, state, or locality. Since the number of teachers is the product of school enrollment and the teacher/pupil ratio, the demand for teachers is commonly viewed as being driven by these two factors.

The demand for new teaching staff at the start of any hiring season depends on (1) enrollment growth, caused by changes in the size of the relevant student population and changes in the entrance or continuation rates of students; (2) changes in pupil/teacher ratios, caused by changes in staffing patterns, class sizes or teaching loads, and program offerings or course requirements affecting the relevant category of teachers; and (3) teacher turnover, the sum of losses resulting from retirements, death, disability, exits into nonteaching employment or homemaking, involuntary losses (firings or layoffs), and promotions.

As discussed in the preceding section, a switch to another teaching position in a different field, school, district, or state constitutes turnover at some level of disaggregation, though individuals who make such switches are not lost to teaching as a whole. Similarly, enrollment growth or increased pupil/teacher ratios in some schools or communities may be offset by declines in others, so that although total demand might stay constant, fluctuations would be apparent at different levels of disaggregation.

FACTORS AFFECTING TEACHER DEMAND

Although the components of teacher demand are fairly clear-cut, they do not add up in a straightforward manner to produce an exact count of teachers needed from year to year. Enrollments, for example, generally produce lagged and nonlinear effects on the demand for

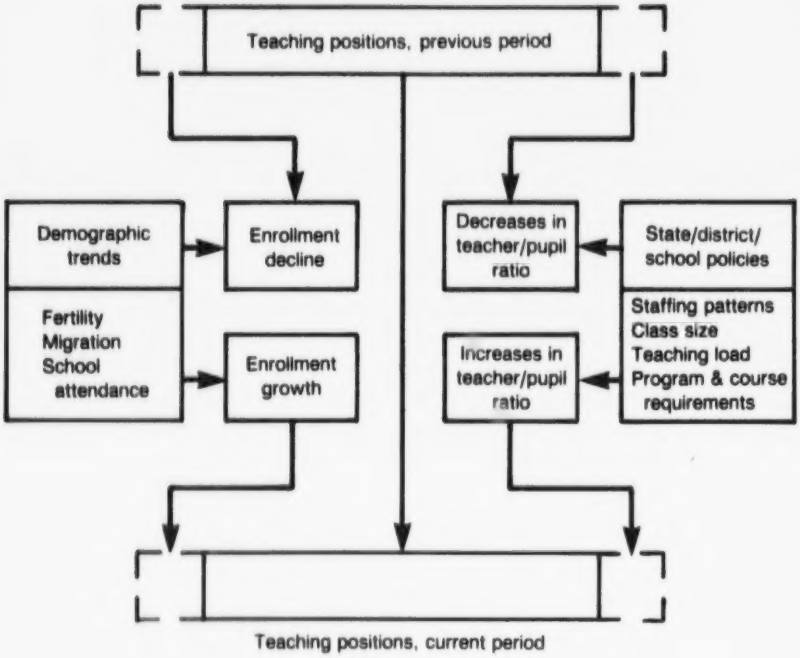

Fig. 3—Components of teacher demand

teachers. An increase or decrease in enrollment does not usually translate immediately into a corresponding proportional increase or decrease in the number of teachers. Adjustments are made to pupil/teacher ratios to smooth the effects of rapid enrollment changes, to accommodate established school staffing patterns and budgets, and to take into account existing contractual agreements with teachers, in the case of enrollment declines.

Teacher demand is also affected by state and local district policies, which mediate the effects of school enrollments on the numbers and types of teachers needed by specifying class sizes, teaching loads, program and course requirements, and staffing requirements (e.g., how

many auxiliary staff must be employed, and what types of staff may perform what types of functions or teach particular types of classes). These demand-related policies are a blend of legal requirements and less formalized practices, which may vary among districts and schools depending on the scope and reach of state statutes or regulations, and the choices made by local districts. School-level policies and practices regarding teacher assignment, curriculum offerings, teaching load, and similar variables interact with these policies to determine school-level teaching positions which, when aggregated, constitute teacher demand.

Pupil/teacher ratios are influenced by a number of factors in addition to school budgets and enrollments. The mix of programs and courses offered to students often dictates different levels of staff resources. Special education courses, for example, require a lower pupil/teacher ratio than others; districts or schools serving a large number of students in such courses may tend to have lower pupil/teacher ratios overall. Similarly, as program and staffing patterns change for school systems as a whole, attendant changes can be expected in the total demand for teachers as well as in the demand for particular types of teachers. The introduction of nearly universal kindergarten, the mandated provision of special education and bilingual education, and the proliferation of auxiliary teaching staff (e.g., counselors, librarians, school psychologists, and resource teachers) are all examples of changes in program and staffing arrangements over the past two decades that have affected demand for particular types of teachers and, in some cases, have influenced overall pupil/teacher ratios as well.

Demand for particular types of teachers also varies from school to school and from district to district, both as a function of community wealth (which influences overall demand) and as a function of community "tastes" for different types of education. Crane (1982), for example, found that the demand for various types of elementary and secondary teachers, expressed as the number of teachers per 1,000 students, varied among districts of different types. Suburban college preparatory districts evidenced higher demand for elementary mathematics, science, and art teachers and secondary arts and humanities teachers, whereas urban and rural districts had higher demand for vocational education teachers. Factors such as community education levels, poverty, and receipt of federal education aid were even stronger predictors of the type of teacher demand than were locational characteristics of districts.

Finally, when relative demand for teachers shifts among fields, as has occurred in recent years (e.g., less demand for teachers in home economics, physical education, vocational education, and business

education, concurrently with increased demand for mathematics and science teachers), school systems often tend to shift senior teachers from low-demand courses to high-demand courses rather than hiring newcomers trained in these fields (Johnston and Aldridge, 1984). If a subject area vacancy is only part-time (e.g., two sections of physics to be covered and three of physical education), the incentive to "cross-assign" is very strong. Thus "misassignment" is a product of both market shortage and district personnel policies regarding staffing and teacher assignment, as well as the fact that demand does not always occur tidily by subject area.

ASSESSING TEACHER DEMAND

Whereas we argued above that the supply of current teachers may best be measured by the numbers of individuals holding particular qualifications, the current demand for teachers is better measured by counts of teachers by the subjects or grade levels they teach. Teacher assignments presumably approximate the demand for teachers of different types; when added to the number of unfilled vacancies by field, we can estimate the total current demand for teachers. This baseline information, which would be obtained largely from a profile of the current teaching force (plus data on vacancies), provides the basis for assessing changes in demand. To be most useful, these changes ought to be assessed by teaching level, field, and geographical location.

In what follows, we examine approaches to modeling and analyzing teacher demand; from this discussion, we draw inferences about appropriate levels of analysis and sources of data for such analyses.

Estimating Changes in Enrollment

Growth in the teacher force can result from enrollment growth or from an increase in the teacher/pupil ratio. Depending on how one defines the term "teacher demand," one might also add the number of qualified teachers employed in administrative, supervisory, and specialist positions within schools, and the unmet demand consisting of positions for which teachers were sought but remained unfilled.

Barring major changes in the conception of elementary and secondary education (e.g., extending near-universal education downward to preschool levels, or eliminating the last year or two of secondary education), enrollment levels can be projected with considerable accuracy, at least at the elementary level. Demographic data regarding the size of the school-age population (birth and mortality rates and the size of the

female population of childbearing age) are readily available, and the effects of unforeseen changes in these factors are felt only after a substantial delay. Given the size of the school-age population, enrollment at each grade level depends upon age-specific enrollment rates, which tend to be very high. However, secondary school enrollment projections must contend with the volatility of dropout rates, which have thus far not proved tractable to behavioral models.

Enrollments at the state or district level are considerably more difficult to project than are national enrollment trends because of the uncertainty of migration trends, the rate of immigration in certain areas (e.g., Texas and Southern California), and the dependence of fertility patterns on race and income levels. Migration trends often follow the economic fortunes of different areas of the country, making long-term predictions difficult. Migration from urban to suburban areas or between suburban areas can be caused by desire to enroll in certain types of schools. This factor can make general migration rates poor proxies for use in district enrollment projections. Finally, the coming baby boomlet entering schools this year will be approximately 50 percent larger for lower-income groups than for higher-income groups. Thus, localized projections must assume different growth rates dependent on the particular population mix in the area. These differential growth and migration rates can have a marked effect on teacher demand by district or state.

The distribution of enrolled children between public and private education, and the related demand for teachers at specific grade levels, are other factors not easily amenable to accurate projection. Although the proportion of students in private schools is small (about 13 percent) and the current difference between public and private pupil/teacher ratios is not large, CES estimates that the number of teachers in private schools increased by 45 percent between 1970 and 1983, from 10 percent of all K-12 teachers to nearly 14 percent (see Table 7). This is due not only to growth in the private sector over these years but also to sharper declines in pupil/teacher ratios in private schools than in public schools. Between 1965 and 1983, overall pupil/teacher ratios declined by 27 percent. This same rate of decrease in public elementary schools' pupil/teacher ratios was matched by a 46 percent decrease in private elementary ratios during the same period.

Table 7

SUMMARY STATISTICS FOR REGULAR ELEMENTARY AND SECONDARY SCHOOLS BY LEVEL AND CONTROL: UNITED STATES, FALL 1965 TO FALL 1983

Fall of Year	Total K-12	Elementary		Secondary	
		Public	Private	Public	Private
FTE teachers (in thousands)					
1965	1933	965	147	746	76
1970	2288	1128	153	927	80
1975	2451	1180	172	1016	83
1980	2463	1177	212	985	89
1983	2462	1175	240	950	97
Enrollment (in thousands)					
1965	48,473	26,670	4,900	15,504	1,400
1970	51,272	27,501	4,052	18,408	1,311
1975	49,791	25,640	3,700	19,151	1,300
1980	46,318	24,156	3,992	16,831	1,339
1983	45,043	23,647	4,315	15,681	1,400
Pupil/teacher ratio					
1965	25.1	27.6	33.5	20.8	18.1
1970	22.4	24.4	26.5	19.9	16.4
1975	20.3	21.7	21.5	18.8	15.7
1980	18.8	20.5	18.8	17.1	15.0
1983	18.3	20.1	18.0	16.5	14.4

SOURCES: NCES (1985a, pp. 45, 73); NCES (1985b, pp. 18, 32, 34).

Estimating Changes in Pupil/Teacher Ratios

Previous studies have projected pupil/teacher ratios by extrapolating past trends. The accuracy of these projections thus depends upon the extent to which these trends will be continued into the future. A school district's pupil/teacher ratio is determined in the course of a complex budget allocation process: School district budgets are based upon the community's perceptions of its educational needs, its ability and willingness to allocate funds to meet those needs, and the amount of state and federal aid received. The school district, in turn, allocates its budget among various school inputs—teachers, aides, supplies, and so on. Pupil/teacher ratios will depend on the costs of purchasing or hiring the various school inputs (e.g., teacher salaries), district commitments (contracts with teachers, tenure policies, agreements with

suppliers of purchased inputs, and the like), and the ways in which the district organizes instructional activities (Carroll, 1973).[1] Furthermore, enrollment changes may influence pupil/teacher ratios: As enrollments decline, teacher organizations and school boards may be willing to forgo salary increases or other instructional supports to keep current teachers employed; when enrollments increase, pupil/teacher ratios may rise to support higher salaries or because of hiring lags (Cavin et al., 1985).

In short, past trends in pupil/teacher ratios will be continued only if aggregate educational expenditures, teacher salaries, and so on change over time in precisely the ways required to yield the implied expenditure and staffing patterns. In light of the prospects for reform of school finance at both the state and national levels, the emergence of stronger teachers' unions, changes in student graduation requirements, and program changes, significant deviations from the implied patterns would not be surprising. However, we have only limited understanding of how these factors change over time and how changes in them affect staffing and expenditure policies.

Thus, available projections of pupil/teacher ratios will probably prove to be reasonably accurate as long as there is no major "shock" to the system. But there appear to be many likely opportunities for major changes in factors that strongly affect the ratio, and we cannot predict which, if any, will occur or when. In theory, we ought to be able to anticipate enrollment changes and policy-generated changes in staffing patterns, such as those that accompany new forms of service delivery (e.g., the now fairly widespread use of specialists in elementary schools or the possible changes in staff responsibilities that may accompany career ladder plans), or new programs and course requirements for students (e.g., the addition of special education, bilingual education, and compensatory education programs during the 1970s, or the changes in student graduation requirements now being enacted in many states).

There are at least two possible sources of data about these elements of teacher demand. First, information can be collected from state or local education agencies about recent policy changes affecting teacher demand (e.g., mandated changes in student program or course requirements, pupil/teacher ratios, and numbers of specialists—counselors, librarians, and so forth). Although officials may not be able to quantify the effects of recent policy changes on teacher demand, the availability of other state- and local-level data about student participation in the relevant courses, programs, or services might allow analysts to

[1]"Open schools," team teaching, and similar departures from the traditional self-contained classroom can generate staffing patterns substantially different from the norm.

do so. At a minimum, tracking changes in enrollments, number of teaching positions by type, and number of leavers by position would allow a count of new positions caused by demand factors other than turnover.

Second, school-level data may be collected on enrollments, staffing patterns, and allocations of teachers across courses and programs. These data would include numbers of FTE staff by type (e.g., teacher, counselor, or librarian) and by courses/grades taught (e.g., number of sections or teacher FTEs for each grade and each type of course—mathematics, science, social studies, and so on). Such data, when aggregated, would allow monitoring of pupil/teacher ratios over time and changes in elements of teacher demand (e.g., number of teacher FTEs allocated to different subjects, functions, and grade levels).

The estimation of demand by teaching field and level is extremely important for meaningful projections of the nature of demand. Such projections can aid teacher preparation institutions and policymakers in planning for shifts in demand among fields as well as changes in overall demand. Estimates and projections of disaggregated demand would be greatly aided by analyses of demand trends by teaching field. Monitoring counts of teaching positions by field over time (adjusted for enrollment changes) would identify fields in which there is growth or shrinkage in demand, and would provide evidence of changes in pupil/teacher ratios.

These kinds of analyses of demand are probably best derived from district-level data rather than from school-level data for several reasons. District size and teaching force composition are more stable than school sizes and types of teachers, since enrollment patterns may shift within districts (with some schools experiencing population increases while others experience declines) and schools may open or close to accommodate population shifts. Furthermore, schools are often specialized in their course offerings (e.g., vocational high schools, magnet schools, and special education schools). Thus, ascertaining demand for various types of teachers at the school level may yield estimates that are not representative for broader populations of students and teachers, unless the school samples are quite large and very carefully selected to represent the distribution of students and teachers by school curricular type.

Finally, since teacher hiring and the establishment of teaching positions are district-level activities, overall estimates of demand and shortage are best ascertained by surveying districts. As we discuss in the next section, however, these estimates, particularly of shortage, should be supplemented by data from schools and teachers to provide multiple indicators of the existence, causes, and effects of shortage.

V. TEACHER SHORTAGE

Although factors influencing supply and demand can be better analyzed by incorporating the kinds of data described in the preceding sections, even these improvements will be inadequate to reveal the labor market forces that produce teacher shortages. The definition and measurement of shortages present special problems, which are considered in this section.

It is important to recognize that estimates and projections of overall teacher supply and demand cannot be compared to produce meaningful estimates of shortage or surplus. Absolute shortages, as measured by unfilled positions for which no candidates are available, occur rarely because school and district administrators can ordinarily adjust teaching schedules, class sizes, and course offerings to "solve" staffing exigencies, at least temporarily. Aside from the numbers of positions available and the numbers of candidates-at-large, many other factors come into play to determine the size and composition of the teaching force and the degree to which there are—in given locations and for particular types of vacancies—more or fewer teachers than desired.

Using data from the 1979 Survey of Teacher Demand and Shortage, for example, CES reported 11,300 unfilled vacancies (4.4 per thousand current teachers) and, at the same time, slightly more than twice that number of layoffs (23,900) (NCES, 1982). At a time when national estimates and conventional wisdom suggested that there were substantial surpluses, many vacancies could not be filled. In some fields, such as English, social studies, and physical education, layoffs far outstripped shortages, whereas the reverse was true for physical sciences, suggesting possible field-related imbalances. However, in others, such as mathematics and special education, the numbers of layoffs and shortages were nearly equal, suggesting location-specific shifts in demand relative to supply.

And although estimates of supply have shown shrinking numbers of entering teachers since that time, with an upswing in demand just beginning, the numbers of unfilled vacancies reported in 1984 were smaller than those reported in 1979. In addition to evidence that the teacher reserve pool is currently being tapped, there are many other reasons why estimates of supply and demand do not add up to estimates of shortage or surplus. Key among these are the definitions of shortage and treatments of vacancies that stem from alternative conceptions of what constitutes qualification to teach and, hence, "legitimate" supply.

VACANCIES, SHORTAGES, AND THE NEED FOR MULTIPLE INDICATORS

It is important to distinguish between levels of vacancy and levels of shortage. A vacancy indicates that a current position is unfilled and that a commitment has been made to hire someone to fill the position. Vacancies arise either from an individual leaving a current position or from the creation of a new position. Because there is almost always a delay between the occurrence of a vacancy and the filling of the position, a level of unfilled vacancies will always exist regardless of whether there is an overall labor shortage or surplus.

Another factor that can affect the level of vacancies is the adequacy of a district's planning process. Poor planning can raise the level of vacancies in a school district because of greater uncertainty in projecting enrollments or teacher turnover. If more children register for school than was projected or a greater than projected number of teachers make decisions not to teach, then hiring will be insufficient and unfilled vacancies will occur.

The duration of vacancies may be more important than the number of unfilled vacancies at any point in time. The duration of a vacancy may depend on the tightness of the labor market at current salary levels, the employer's standards in filling the position, the efficiency of the personnel office, the length of the administrative process required for hiring, the quality of the planning process, and the job status of the individual being hired. If an employer is unwilling to tolerate the vacancy, then a marginally qualified candidate might be found and emergency certification provided. Districts willing to compromise on standards may have few long-term vacancies. Districts less willing to compromise may search longer for qualified candidates. Individuals may delay in accepting job offers while they consider alternatives or give notice at their previous place of employment.

Data on unfilled vacancies can be difficult to interpret without understanding the other factors besides labor shortage that can contribute to the level and duration of vacancies. It is improper to make inferences about labor market "shortages" from the level of unfilled vacancies without taking these other factors into account. In particular, drawing inferences across teacher areas or districts without taking account of these other factors can present a misleading picture about "shortages."

A shortage situation is reflected by a "persistent" set of unfilled vacancies because qualified teachers at the current salary level and certification standard are not available. This definition accepts that an "equilibrium" level of vacancies will always be present and will be exceeded if there is an insufficient supply of labor at the prevailing salary and certification standard. Where that occurs, vacancies will

take longer to fill, and the average level of unfilled vacancies will rise. A shortage exists if this level of vacancy is above a "natural" level and is due specifically to an insufficient supply of appropriate candidates rather than to other factors.

Since the level of vacancies is not solely dependent on labor shortages, the measurement and interpretation of data on vacancies must be done with caution. Changes in vacancy levels that cannot be explained by changes in teacher force composition, poor planning, or changes in the dynamics of the labor market might be interpreted as evidence of teacher shortages. This evidence will probably be more persuasive if large changes occur in unfilled vacancy trends or if such vacancies are of longer duration. However, even with good data on both the level and duration of vacancies, vacancy rates will remain only a single, and somewhat difficult to interpret, indicator of potential teacher shortage.

In general one needs to monitor several different aspects of the teacher labor market to understand its internal dynamics. Interpretation of any single trend can be misleading, but interpretation of the movement of several trends—combined with a theory of labor market behavior—can serve to increase our confidence that we understand what is happening. For instance, in one state we might see no increase in the number or duration of unfilled vacancies but increases in emergency certification; in another state we might see no increase in emergency certification but increases in the number and duration of vacancies. In both states a labor shortage may be causing this behavior, but different policies are being used to address the problem. If we depended on only a single indicator, we would have difficulty interpreting what is taking place, but observing both vacancy levels and emergency certifications makes the phenomenon more understandable.

Several indicators of potential and actual teacher shortage may signal that the labor market is getting tight. Multiple indicators are necessary because of the flexibility of school district policies to adjust to shortages. These adjustments can occur either on the supply or demand side and will differ from district to district and state to state. The indicators could include:

- Increases in real salary levels—especially for beginning teachers;
- Increases in emergency certifications;
- Increases in "full-time" substitute teachers;
- Increases in the average number of offers received by new education majors;
- Increases in the number and average duration of vacancies;
- Increases in class size; and
- Increased occurrences of out-of-field teaching.

Despite the value of multiple indicators of labor market shortage, considerations of cost and respondent burden require care in selecting indicators that may be sustained over time. Below we discuss some of the indicators of teacher shortage that can be obtained through surveys of districts, schools, and teachers.

LABOR MARKET INDICATORS OF TEACHER SHORTAGE

Perhaps the key indicator of shortage is a significant level of real increase in teacher salaries—particularly for beginning teachers. Unfortunately, salary increases may be a lagged indicator, occurring after rather than before a shortage. Real teacher salary increases—because they are difficult to enact—indicate a dissatisfaction with current staffing and difficulties in recruiting new teachers and provide convincing evidence that districts are having trouble hiring and keeping quality teachers.

Additional indicators of shortage depend on definitions of who is qualified to teach what subjects and how positions may be filled. As an example of how definitions of teacher shortage vary, consider two extreme views of teacher substitutability. If teachers of different backgrounds are always perfect substitutes for one another (e.g., an elementary school teacher can as easily teach high school mathematics and a junior high industrial arts teacher can as easily teach kindergarten), then estimates of total teacher supply and total teacher demand are all that count.

In fact, this view seems to underlie most general projections of teacher supply and demand, where counts of teacher supply include anyone who is teaching (or has taught), regardless of qualifications. This method of counting stems from the lack of uniform standards for assessing qualification to teach and nondiscriminating measures for counting teachers. These measures reflect states' and school districts' willingness to hire individuals without standard credentials as teachers when the need arises, or to reassign current teachers outside their areas of preparation. These individuals then become part of the teacher pool, and it becomes almost impossible to discern a shortage, since vacancies are nearly always filled somehow with someone. The analogy would be to calculate in the supply of physicians anyone willing to offer his or her services as a doctor, regardless of training or licensure, in an environment where significant bars to this practice did not exist. Thus, the recent CES Surveys of Teacher Demand and Shortage report few "shortages" as measured by unfilled vacancies, whereas projections based on qualifications to teach have anticipated shortages, and

surveys of teachers suggest that a nontrivial proportion teach outside their fields of preparation or certification.

At the other extreme, if we assume that teachers are totally nonsubstitutable and that teachers can teach only those subjects or levels for which they have particular preparation, then separate computations of supply and demand by field would be essential, with acute shortages obvious in some and surpluses obvious in others. Individuals hired or assigned to teach in areas for which they lack the particular qualifications used as a discriminating measure would be eliminated from counts of "legitimate" supply, thus producing measures of "latent" if not "blatant" shortages.

Because teaching is not a highly developed profession, no single organized entity exists for defining minimum qualifications for a particular teaching assignment. However, some indication of the degree to which the demand for specific types of teachers is matched with a supply of appropriately trained teachers is essential for policymakers concerned with teacher supply and quality. Given that there is disagreement about measures of teacher quality, several different measures could be used to derive qualifications-related supply estimates. These might include certification in the fields taught, college coursework and additional in-service preparation in those fields, and pedagogical preparation. Such indicators would allow policymakers to at least track supply, demand, and shortage according to various definitions of "legitimate" supply and would provide some means for reconciling currently disparate estimates.

Although data are not available to demonstrate conclusively how qualifications-related measures of supply and demand would affect estimates of shortages, some sense of the possible magnitude of differences in estimates derived from alternative assumptions can be gained from recent surveys. The 1983–84 NCES estimates of teacher shortage, based on a measure of unfilled vacancies reported by a sample of school districts, indicate overall shortages in the neighborhood of only 1.6 per thousand current teachers (or 19 per 1,000 vacancies), with field-specific shortages ranging from 0.4 per thousand for reading to 8.8 per thousand for bilingual education (NCES, 1985b).

This range may reflect supply as it interacts with the outer bounds of teacher substitutability in different fields. That is, a number of individuals might well be viewed as capable of teaching reading, but the potential supply of bilingual education teachers is limited to individuals who are, in fact, bilingual themselves, aside from the application of any credentialing standards. On the other hand, the number of unfilled vacancies in a particular field may also reflect a view that some courses are more dispensable than others; in these fields, difficult-to-fill vacancies may be left unfilled rather than filled with uncertified candidates. Thus, if all students must take high school English, vacancies cannot

be left unfilled; however, an upper-level mathematics course may simply be cancelled if a candidate cannot be found.

To provide a better indicator of current shortages, counts of unfilled vacancies should be represented as a proportion of the total number of *vacancies* in a given year, not as a proportion of the total number of *current* teachers. The latter tabulation does not take into account year-to-year changes in demand or hiring rates; thus it does not reveal the degree to which current positions were adequately filled. Because data from the CES demand and shortage surveys are not reported as a proportion of posted vacancies, it is impossible to determine, field by field, the degree to which real shortages compared to hiring needs existed. In addition, data to reveal the proportion of new hires underqualified for their teaching positions were not collected field by field. These changes in data collection and reporting would go a long way toward providing better indicators of the extent of shortages.

Applying a standard other than unfilled vacancies leads to quite different estimates of shortage. For example, the same 1983–84 survey provided estimates of the proportion of total and newly hired teachers not certified in their principal field of assignment; these amounted to 3.4 percent of all teachers and 12.4 percent of all newly hired teachers. If we assume that no certified applicants could be found for the vacancies filled by uncertified teachers and added these 26,300 positions to the count of unfilled vacancies, the estimate of shortages would increase by nearly tenfold to 12.3 per 1,000 current teachers and over 14 percent of all vacancies (see Fig. 4). If we further assume that the positions filled by other teachers assigned outside their fields of certification could not have been filled by certified applicants (a more dubious assumption), the estimates would rise further.

Applying still more rigorous standards yields predictably larger estimates. Since certification is not a perfect measure of preparation,[1] we might want to know what proportion of teachers are teaching classes outside their fields of preparation, because this proportion may be counted as evidence of shortage as well as demand. (Again, this requires inferences about hiring and staffing and disallowances of substitutions or economies that are not entirely realistic, given current staffing practices.) A 1980–81 NEA survey of teachers indicates that 16 percent of all teachers teach some classes outside their field of preparation; and 9 percent spend most of their time teaching "out of field" (NEA, 1981); a High School and Beyond special survey

[1]The High School and Beyond survey of high school teachers, for example, indicates that of the small number (1.7 percent) of high school teachers who have had *no* college courses in the field they most frequently teach, 74 percent are nonetheless certified in that field (Carroll, 1985).

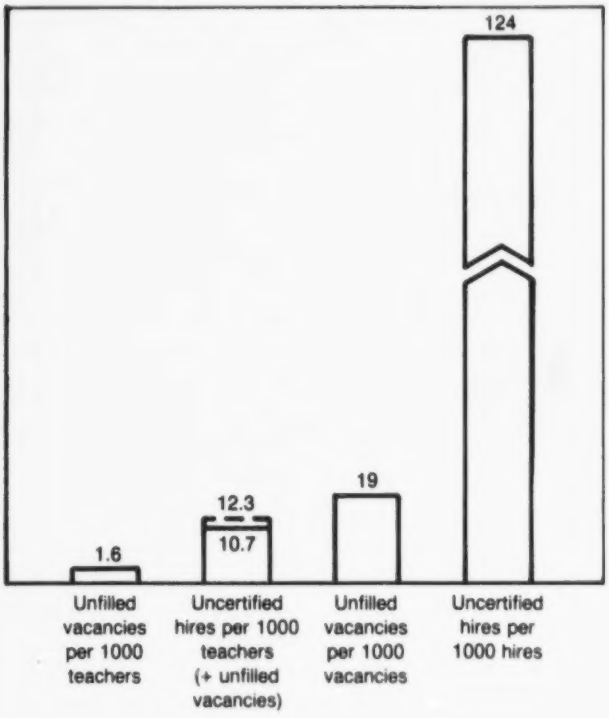

Fig. 4—Alternative indicators of shortage

supplement of 10,000 teachers indicates that, among high school teachers, 11 percent teach primarily outside their area of state certification and 17 percent have less than a college minor in the field they most frequently teach (Carroll, 1985) (see Fig. 5).

To be sure, we do not know the degree to which such out-of-field assignments are actually inappropriate according to various standards, or the degree to which they impair teaching quality; nor do we know the extent to which the discontinuation of some of these types of hiring and assignment practices would influence teacher demand or shortage. Some of these practices undoubtedly result from capitalizing on

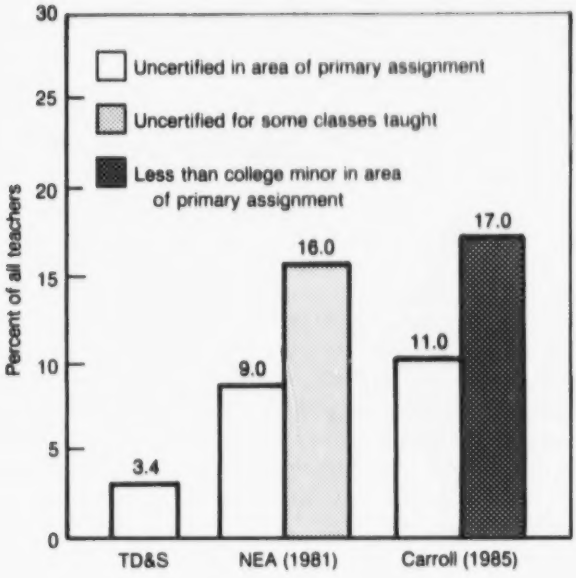

Fig. 5—Alternative indicators of misassignment

teachers' individual uncredentialed abilities and interests; some result from district attempts to continue to employ senior teachers when demand in their particular teaching fields declines; some are probably supported by in-service training that upgrades current teachers' qualifications. On the other hand, misassignment as a response to teacher shortages may also result in poor teaching in some unknown proportion of instances, and in any event produces a distorted picture of teacher supply.

Understanding the policy implications of teacher supply and demand—and of the distribution of teacher qualities across schools and classrooms—requires a full picture of school staffing practices and, in turn, their implications for teaching practices. When imbalances in the supply of and demand for teachers occur, school districts may adopt strategies that create suboptimal learning experiences for students. Among these strategies are the assignment of teachers to teach

courses outside their fields of preparation, the enlargement of class sizes or expansion of teaching loads, and the cancellation of (usually upper-level) courses that cannot be even marginally well taught by untrained teachers.

This suggests that surveys of school-level administrators ought to include questions about their hiring and assignment practices. For example, we would want to know how vacancies are filled at the school level (reassignment of other teachers, transfers from other schools, or new hires); the degree to which the principal has control over the definition and filling of vacancies; the degree to which part- or full-time vacancies were difficult to fill (or were left unfilled); and the results of such difficulties (e.g., increased class sizes, or reassigning current staff to particular classes they have not previously taught). If such administrative practices are politically sensitive, we might expect less than candid responses. Thus, other sources of data on such things as the extent of out-of-field assignment are desirable.

To understand the interactions between teacher supply and qualifications and assignments, we also need data from teachers about their formal qualifications, additional in-service training, teaching assignments, work histories, and plans. The assignments of new hires, especially, may reveal the ways in which demand translates into positions and courses taught, and the work histories of current teachers may reveal the ways in which cross-assignment and field-switching occur.

Finally, it is important to monitor field-specific shortages of teachers *in relation to* changes in demand by field. If, for example, we find that demand for mathematics teachers appears to be increasing and that many posted positions were unfilled or filled by uncertified candidates, we can look at the characteristics of incoming teachers to ascertain whether shortages exist, are likely to be long-term, or are easily remediable. If demand appears to be growing in areas that have not previously shown growth (e.g., elementary teachers), we can look at the expected continued supply of those teachers in the current force and evidence of the size of the pipeline to ascertain whether future shortages are likely.

Indicators of shortage should serve as flags to call attention to particular areas of disequilibrium, rather than as characterizations of the equilibrium between overall teacher supply and demand. They should inform and be informed by estimates and projections of supply and demand, illuminating questions of the *distribution* of teachers across fields and locales as well as questions of changes in demand and the adequacy of supply.

VI. PROJECTIONS OF TEACHER SUPPLY AND DEMAND

The preceding sections described the major components of teacher supply and demand and discussed key factors that influence the teacher workforce. This section and those following it outline the considerations that should guide the development of a federal data-collection system for assessing supply and demand.

THE NEED FOR PROJECTIONS

Once the Schools and Staffing Surveys are fielded and better data on the current status of teaching become available, it seems likely, based on existing bits and pieces of information from many sources outside CES, that the nation's teaching force will be found wanting in ways that will call for policy interventions at several levels of government. To determine the types and degrees of remedial actions that are needed, educational decisionmakers need to have more precise measures of current shortfalls and good indicators of the extent to which staffing problems may worsen over time in the absence of policy changes. This requires having reliable, up-to-date information about the national teacher labor market and detailed data that permit analyses of school policies that may affect future supply and demand. This section, which examines modeling considerations and data requirements for making projections of teacher supply and demand, will pinpoint gaps in CES's current data base on teachers and will provide a framework for specifying data requirements for meeting educational scholars' and policymakers' future needs in this area.

Ideally, rational policymaking affecting teachers should be based on a comprehensive set of current estimates and reliable projections of teacher supply and demand by field, level, sector, and location. Realistically, reliable projections at that level of disaggregation are figments of the imagination, partly because actual supply and demand levels depend on myriad field- and location-specific factors that may not be feasible to measure in national surveys, let alone incorporate into projections. The fact is that, absent a crystal ball, the future outlook for teachers remains opaque because of unpredictable events, changes in policies that affect teachers, and the unknowable responses of current teachers and persons in the teacher pipeline as they weigh teaching

careers against alternative professional employment and other pursuits. Nevertheless, projections based on good data can provide "ballpark" estimates that can serve as valuable indicators of what may transpire if past trends persist, and they can help focus attention on major problem areas surrounding flows into and out of teaching that may be amenable to solution through policy interventions at the right level.

This section will examine projections of teacher supply and demand in general terms to explore their nature, examine their potential as indicators, and determine the data requirements needed to carry them out. CES's projections of teacher supply and demand will be used to examine the shortcomings of projections based on incomplete data and to draw implications for gathering data through periodic surveys of teachers and administrators.

MODELING CONSIDERATIONS

Projections are ordinarily based on some type of "model." Figure 1 depicted a very crude model of some sector of the teaching force (e.g., all precollege teachers, or the subpopulation of secondary science teachers in Colorado public schools). The model serves as a first step in the projections process, which is to identify the quantities of primary interest, their relationships to one another, and their dependencies on other factors, such as school enrollments, that are presumably more amenable to precise forecasting.

Insofar as national projections of teacher supply and demand are concerned, it is natural to focus attention on stocks of teachers, former teachers, and potential teachers, and to consider their transitions (or flows) across categories that correspond to sources of supply or demand. The stock of teachers, $T(t)$, at the beginning of school year t can be divided into four components of teacher supply: (1) new entrants into the system; (2) former teachers who are reentering the system; (3) holdover teachers from the preceding year; and (4) immigrants into the system. This decomposition of the stock of teachers in year t can be expressed in the form

$$T(t) = N(t) + R(t) + C(t) + I(t),$$

where the terms represent the counts of new, reentering, continuing, and immigrant teachers in year t.

Each of the four terms on the right can be thought of as "takes" from four stocks of potential teachers in year t. The new teachers can be thought of as coming from the teacher pipeline in year $t - 1$; the reentrants come from the reserve pool of former teachers;

the continuing teachers come from the stock of teachers at the start of the preceding year; and the immigrants come from the stock of teachers outside the system who are potential immigrants into the system. Note that if the system under consideration consists of teachers in a particular field (say, mathematics), the immigrant category would include those who shift over from other fields while remaining in the same school. Since field-shifting of this type is often done piecemeal (e.g., by having an erstwhile science teacher teach two sections of algebra), there are some important definitional problems associated with these categorizations that need to be solved in planning surveys to fathom this source of teacher supply. For now, we simply note that these problems can be addressed partly by gathering detailed information on teachers' class assignments and by shifting attention from counts of teachers to counts of FTEs.

Returning to the case where the counts are for all teachers at a particular level or for teachers in a particular state, the "supply" of teachers in year t might be defined to be the sum of the four population counts listed above. But, with the exception of the previous year's teaching force, the other populations (i.e., the teacher pipeline, reserve pool, and potential immigrant pool) are difficult to circumscribe. Even if the total of the population counts could be obtained, it would be a meaningless number.

One way to provide a simpler, more workable notion of "supply" for projection purposes is to treat the continuing teachers separately and to restrict attention to the supply of "new teachers." Another approach is to focus on those subpopulations of potential teachers that are either the main sources of supply or for which time series of counts are readily available. For instance, CES restricts its attention to projecting the supply of "new teacher graduates" and uses the corresponding cohort of bachelor's degree recipients as the population from which the graduates are drawn.

The point is that "teacher supply" is a fuzzy concept and, before projections of teacher supply can be contemplated, one must decide what the term "supply" includes. If it includes new teachers from all sources, reentrants from the reserve pool, and immigrants (as we feel it should), then this implies a need for appropriately detailed data on teachers to determine their sources of entry into the profession as well as source population sizes and other factors that can be used to forecast future supplies from the various components. These data requirements will be made more explicit later.

Although the meaning of the expression "teacher supply" is vague, there is substantial agreement as to what is meant by "teacher demand." The demand for teachers in year t, denoted by $D(t)$, is

ordinarily defined as the number of new teachers added that year, $T(t) - C(t)$, plus the "unmet demand" $U(t)$, which is the number of positions for which candidates were sought but none were hired. Thus,

$$D(t) = T(t) - C(t) + U(t).$$

Letting $G(t)$ denote the growth $T(t) - T(t-1)$ in the teacher force from year $t-1$ to t, and letting $L(t)$ denote the losses $T(t-1) - C(t)$ resulting from turnover between years $t-1$ and t, we observe that the demand for additional teachers in year t can also be expressed in the form

$$D(t) = G(t) + L(t) + U(t).$$

The main uncertainty in defining demand is associated with the notion of unmet demand or "shortages." One can argue that, in most schools, unmet demand does not exist ("supply equals demand") because of the flexibility that school administrators have in hiring marginally qualified teachers, reassigning teachers to fill vacancies, changing course offerings, modifying class sizes, or relying on part-time, substitute, or itinerant teachers. On the other hand, some school administrators, in responding to previous fieldings of the Survey of Teacher Demand and Shortage, report nonzero counts of teaching positions that remained vacant, were abolished, or were transferred to another field because suitable candidates were unavailable. Whether these counts of shortages are included in demand or not, they constitute what may be the best available direct evidence of instances where demand exceeds supply. Indirect evidence of shortages are provided by counts of uncertified teachers, those with temporary or emergency certification, and those who are teaching out of their fields, all of which may signal an inability to attract qualified teachers to fill specific vacancies.

The growth component of demand, $G(t)$, can be decomposed into two parts—one associated with enrollment growth $E(t) - E(t-1)$ between year $t-1$ and t, and a second component associated with the year-to-year change in the teacher/pupil ratio $R(t) = T(t)/E(t)$. To facilitate defining these two components precisely, one can express the growth in teacher force $G(t)$ in other forms as follows:

$$G(t) = T(t) - T(t-1) = R(t)E(t) - R(t-1)E(t-1)$$

$$= [R(t) - R(t-1)]E(t) + R(t-1)[E(t) - E(t-1)].$$

The first term on the right in the last expression is referred to in NCES (1985a, p. 25), as the number of "additional teachers needed for teacher/pupil ratio changes," and the second term is referred to as the number of "additional teachers needed for enrollment changes."

The most important component of demand for additional teachers may be the loss component, $L(t)$, which is also termed "teacher turnover." This can be decomposed into several subcomponents corresponding to the reasons for the loss—employment in another teaching job, nonteaching employment, retirement, disability, death, leave-taking, emigration, etc. Though turnover does not affect *aggregate* teacher demand (i.e., the total number of teaching positions available), it greatly affects the demand for *new* teachers at any point in time. As will be seen below, losses resulting from teacher turnover are projected to exceed other components of teacher demand by a wide margin over the next several years. Given the importance of teacher turnover in projecting future demand for teachers, one would think that data on teacher turnover would be routinely gathered. However, these losses have not been surveyed by CES since 1969, leaving a critical gap in the data base. Since any method for projecting future demand for teachers must necessarily include a means for projecting teacher turnover, preferably by type of loss, field, and state, data on teacher turnover and the factors that are related to turnover are essential elements for projection purposes.

NATIONAL PROJECTIONS

The methodology that CES uses in projecting teacher supply and demand is outlined in NCES (1985a), which provides tables showing three series of projections (low, intermediate, and high) of teacher supply and demand through 1992. Tables B-21 and B-22 in that report break out the individual components of projected teacher demand separately for public and private schools. Table B-23 provides projections of new teacher graduates.

In terms of the preceding formulation, CES demand projections do not include the "unmet demand" component, but they do include the two separate growth components for enrollment changes and changes in teacher/pupil ratios. Table 8 summarizes CES's intermediate projections of teacher demand.

The first thing to note about these projections is that the teacher turnover component of projected demand completely swamps the other two components. The second thing is that a substantial portion of the remainder is attributed to projected increases in teacher/pupil ratios.

Table 8

ESTIMATED DEMAND FOR TEACHERS IN REGULAR ELEMENTARY AND SECONDARY SCHOOLS
(In thousands)

Year	Total Demand	Additional Demand			
		Total	For Enrollment Changes	For Teacher/Pupil Ratio Changes	For Teacher Turnover
1980	2439	127	−36	16	147
1981	2403	110	−42	6	146
1982	2401	143	−29	27	146
		Intermediate Projections			
1983	2404	148	−25	28	145
1984	2401	142	−16	13	145
1985	2413	157	1	11	145
1986	2438	170	9	16	145
1987	2452	160	−3	17	146
1988	2468	164	1	15	148
1989	2493	173	11	14	148
1990	2527	183	20	14	149
1991	2569	195	28	16	151
1992	2624	209	42	13	154

Since the third component of demand is associated with enrollment changes and that component is more predictable than the other two, the credibility of CES projections hinges on the projections of teacher turnover and changes in teacher/pupil ratios.

The growth components of demand are projected by substituting projected values of teacher/pupil ratios, $R(t)$, and projected values of enrollments, $E(t)$, in the last expression for $G(t)$ listed above. The projected values of the teacher/pupil ratios are estimated using four equations (one for each level/sector combination) of the form

$$R(t) = 0.5c + 0.5(a + bt).$$

The constants c for the four equations are chosen to accord with the most recently observed values of $R(t)$, and a and b are regression coefficients for equations fitted using exponential smoothing. This amounts to choosing projected values of $R(t)$ that are midway between CES's other projections—the "low projections" for which the projected values of $R(t)$ remain constant at c, and the "high projections" that accord with linear extrapolation based on past trends.

The enrollment projections are based on age-specific enrollment rates derived from Bureau of Census projections and adjusted to accord with CES data on enrollments by grade and sector. For the purposes of this discussion, we simply observe that these projections depend upon having time series of enrollments and counts of teachers by sector that are sufficiently reliable to be incorporated into the projections process. For reasons that will be spelled out more fully in Sec. VIII, CES has not had precise estimates of counts of teachers and enrollments in the private sector since before 1980, if then. Given that the proportion of students enrolled in private schools has been increasing over time and that staffing practices in the private schools are quite different from those in the public schools, we need more reliable population estimates for the private schools to ascertain recent trends before we can place any credence in projections that are derived from those estimates.

A more telling problem with CES's demand projections is the method for projecting teacher turnover, the predominant component of teacher demand. Teacher turnover is projected to be a constant 6 percent of the previous year's teaching force for all four level/sector combinations under the intermediate projections, and constant turnover rates of 4.8 and 8 percent are assumed under the low and high projections. Since national surveys to obtain appropriate turnover data have not been conducted since 1968–69 when the overall turnover rate was estimated to be about 8 percent (Metz and Fleischman, 1974), whether or not the 6 percent figure is close to the current rate is unknown. Given that changing the projected turnover rate from 6 percent to 8 percent would increase projected teacher demand by about one-third, we see that current projections of teacher demand are subject to substantial error.

Table 9 summarizes CES's projections of the supply of new teacher graduates. The table mimics Table B-23 in NCES (1985b) by including a column for estimates and projections of teacher demand and another column headed "Supply As a Percent of Demand" that contrasts CES's projections of supply and demand.

CES projections of the estimated supply of new teacher graduates are derived using the time series that results from expressing NEA's estimate of new teacher graduates as a percentage of the total number of bachelor degree recipients in the same year. The intermediate projections are based on the assumption that this percentage will remain stable at 15 percent, the 1982 figure. The low projections, which are listed in parentheses in Table 8, result from fitting a nonlinear regression function in year t to the observed percentages for the last 10 years and then extrapolating the function to future values of t.

Table 9

ESTIMATED SUPPLY OF NEW TEACHER GRADUATES
(In thousands)

Year	Estimated Supply of New Teacher Graduates	Estimated Demand for Additional Teachers	Supply As a Percent of Demand
1980	144	127	113.4
1981	141	110	128.2
1982	143	143	100.0
	Intermediate (and Low) Projections		
1983	146 (132)	148	98.6 (89.2)
1984	146 (126)	142	102.8 (88.7)
1985	144 (121)	157	91.7 (77.1)
1986	142 (115)	170	83.5 (67.6)
1987	140 (110)	160	87.5 (68.8)
1988	139 (107)	164	84.8 (65.2)
1989	139 (105)	173	80.3 (60.6)
1990	139 (102)	183	76.0 (55.7)
1991	138 (100)	195	70.8 (51.2)
1992	137 (99)	209	65.6 (47.4)

Given that the percentage of new teacher graduates dropped consistently from 35.8 in 1970 to 15.0 in 1982 and followed a pattern like that of the fitted regression function used in the low projections, the intermediate projections based on a constant percentage have little credibility in this case. Therefore, contrasting these projections with CES projections of demand, as is done in the third column, is highly questionable.

On the other hand, the low projections reflect past trends better and offer some hope of being in the right ballpark. Even if the projections of demand are off by one-third in either direction, one can see from these projections that there is an increasing supply/demand imbalance in the offing unless other sources of supply can make up the difference. This illustrates that relatively crude projections can serve as indicators that can signal decided imbalances between supply and demand. Allan Cartter (1965) used a similar projection methodology in 1965 to predict that overproduction of Ph.D.s would lead to a surplus of college faculty by 1970; his warning did not prevent the surplus but it may have served to lessen its impact.

STATE PROJECTIONS

Individual states can tap their own data bases on teachers to provide more detailed projections of teacher supply and demand. One set of projections that merit special attention are those for California by Cagampang et al. (1985). They used two methods to project the components of teacher demand resulting from retirement and attrition, one of which uses the average annual attrition rate (7.67 percent) from the State Teachers' Retirement System over the last seven years, and a second which uses a linear equation fitted to the observed rates.

Of greater interest is the authors' methodology for projecting the supply of teachers from the four sources cited above: beginning teachers, reentrants from the reserve pool, continuing teachers, and immigrants from out of state. To provide a more refined breakdown of supply, they divide the beginning teachers into two categories: (i) recent graduates of California teacher credential programs, and (ii) college graduates who pass the California Basic Educational Skills Test and obtain emergency credentials. To project reentrants, they delineate a reserve pool of teachers that "contains at most 167,000 teachers with valid K-12 credentials who are not currently teaching."

Among other things, this study shows that projections of teacher supply and demand by component can be developed that permit projections of shortfalls under certain assumptions about the continuance of prevailing policies. They also provide estimates of the extent to which the shortfalls would increase under three assumptions reflecting possible policy initiatives to upgrade California schools: (1) The pupil/teacher ratio is reduced to 20 to 1; (2) no emergency credentials are issued; and (3) teachers are restricted to teaching only in their fields of expertise. Since their demand projections are done at the county level and they are able to provide some useful information about the demand for teachers by field, their work constitutes a proof that detailed projections of teacher supply and demand are possible. They also establish that projections of this type can provide comprehensive, policy-relevant information to guide state and local education officials, including estimates of shortfalls in supply in the absence of policy changes.

VII. DATA REQUIREMENTS

This section considers the data requirements for addressing key questions related to teacher supply and demand. Our list of key questions includes the following:

- What are the qualifications, experience levels, demographic characteristics, financial statuses, and career intentions of this year's teaching force?
- How many losses were there from last year's force? What were the reasons for leaving? Where did they go? Were the losses voluntary or involuntary, preventable or irremediable, temporary or permanent?
- How many new teachers will be needed this fall? Will there be enough teachers of the right types available to meet the demand? If not, where will the shortfalls occur, and in what fields? What policies might alleviate the shortages?
- Where will the new teachers come from? Is the teacher pipeline adequately stocked in terms of quantity, quality, fields of specialization, and geographic dispersion? Are there enough recruitable teachers in the reserve pool to fill the gap? How many positions will need to be filled by immigrant, out-of-field, and marginally qualified candidates?
- How qualified will the new teachers be for their assignments? How will they stack up with the experienced teaching force? How many will drop out during or at the end of the first year? How many will make careers of teaching?
- What critical staffing problems exist today? What is the outlook for next year, five years from now, and 10 years from now? What changes in policies are needed to alleviate the most severe problems?

DATA REQUIRED TO PROFILE THE TEACHING FORCE

School teachers constitute an invaluable national resource. As the persons who are entrusted with a mission of vital importance—the education of our children—they play key roles in society. Who they are, how they are trained, what experiences and talents they bring into their classrooms, how they perform their tasks, and how they fare as professional workers are questions of great import.

At a minimum, the nation's information system on teachers should be designed to profile the teaching force along the following dimensions:

- Numbers of teachers by level, sector, and field;
- Utilization (level and nature of teaching assignment, subjects taught, class sizes, other duties);
- Qualifications (teaching experience, certification status, fields qualified to teach, academic background, special training); and
- Demographic and economic characteristics.

Although we expect few challenges as to the desirability of gathering data in each of these areas, we could list many other areas for which the desirability of gathering data is less clear-cut, namely, teachers' living arrangements, attitudes toward teaching, instructional practices, homework policies, extracurricular activities, secondary occupations, community activities, workplace perceptions, job satisfaction, and career plans. Since the list could go on and on, this raises the question as to what criteria should be used for expanding or delimiting data desiderata for profiling the teaching force. If one were to gather detailed data on all these dimensions plus dozens of others using lengthy teacher questionnaires distributed through school principals, this would not only impose an indefensible burden on tens of thousands of teachers but would risk high nonresponse through principals' and teachers' refusal to cooperate in the survey. Because teachers and principals who choose not to participate in such surveys may have attributes that differ systematically from those who do, high nonresponse jeopardizes the validity and, therefore, the value of the survey results. Hence, choices of teacher attributes to be profiled cannot be made lightly.

SETTING PRIORITIES

The considerations of data requirements in this report are being made in the context of redesigning four national surveys that focus mainly on teachers and school staffing issues. As such, it is incumbent on us to give first priority to those items that bear most directly on teacher supply and demand. However, given that the surveys present a golden opportunity to learn more about the teachers and the workings of the nation's schools, the question remains as to what extent the scope of the surveys should be expanded to provide a more comprehensive profile of the teaching force.

In particular, it is tempting to consider extending the survey objectives to examine the role of the teacher in the educational process. It can be argued that, despite decades of studies of teacher and school effectiveness, our knowledge of how instructional practices, staffing policies, school climate factors, parents, and nonschool factors interact to enhance student learning remains sketchy, and national surveys of teachers may provide important insights into that process. The counterargument is based on the observation that the educational process is an extremely complicated enterprise in which millions of students with disparate abilities, backgrounds, interests, and temperaments interact with their teachers in highly individualized, unpatterned ways and under extremely varied conditions that may completely negate or partially mask both exemplary and utterly inept teaching performances. Therefore, we believe that any definitive analysis of teachers' roles must necessarily be consigned to comprehensive research-oriented surveys such as High School and Beyond, the National Assessment of Educational Progress, and the forthcoming National Education Longitudinal Study, where measures of student progress along numerous dimensions are obtained, as well as a full array of measures of school factors in addition to teacher and teaching attributes that might affect learning and development.

Another consideration behind our recommendation to focus the surveys on teacher supply and demand issues is that the "coming crisis in teaching," associated with the probable difficulties that many schools will encounter in meeting the future demand for qualified teachers, is of paramount importance for its own sake. The timing, breadth, and depth of the crisis must be monitored closely to guide public policies that will be needed to alleviate it. With adequate planning and a greatly improved national data base, the schools' future staffing problems will become more measurable, analyzable, and perhaps tractable, provided the surveys are well designed, appropriately fielded, and followed by timely analyses and dissemination of results. Our specifications of data requirements below and our later recommendations for changes to meet them are based on the premise that the most important objectives of the Schools and Staffing Surveys are to provide a data base for pinpointing the existence and severity of school staffing problems and for assessing and projecting teacher supply and demand.

Although focusing on supply and demand issues simplifies the priority-setting problem somewhat, it is only a first step in prescribing data requirements. That this focus does not serve to delimit the survey items needed to profile the teaching force becomes apparent when one considers that teacher turnover, the main component of teacher demand, may depend on teacher satisfaction, autonomy in prescribing

course content, principal/teacher interactions, policies regarding extracurricular activities, and a host of other factors that may bear only indirectly on individual decisions to change teaching assignments, seek employment in another field, or drop out of the labor force.

A second step in ascertaining data requirements involves weighing the costs and benefits of various types of data. Although that cannot be done precisely, a consideration of the costs and possible benefits to be realized forces us to examine more fully the potential uses of the data and the consequent gains in information to be realized. Certainly one use will be to provide a data base for assessing the current teaching force and projecting teacher supply and demand. This implies that all the data elements required for the projections must be included in the data base. Another use of the data is to provide the wherewithal for analyzing flows into and out of the teaching force as functions of teacher attributes, school policies, and other factors. The data requirements for both types of analyses will be discussed more fully later.

THE NEED FOR DISAGGREGATED DATA

The answers to many questions about teacher supply and demand depend on having time series of counts, estimates, and projections of current teachers, shortages, turnover, and new additions to the teaching force—all disaggregated by field, level, sector, and state. For some purposes, a further breakdown by certification status (or other measure of teacher "quality") is needed to provide indicators of problem areas in staffing that may not be apparent from other statistics. In addition, reasonably large, representative samples of new and continuing teachers are needed within each of the cells defined by field, level, sector, and state to profile the teachers in each cell and to permit drawing comparisons across cells, pinpointing problem locations and fields, and guiding policy choices.

Since the provision of these counts, estimates, and projections is no mean task, the need for them calls for some explanation. First of all, reliable time series of enrollments and counts of (FTE) teachers by level and sector are essential for monitoring and projecting teacher supply and demand (e.g., to determine trends in teacher/pupil ratios), but they are also needed to fulfill CES's mission to report full and complete statistics on the nation's schools—both public and private. In the past, CES has routinely published national time series of enrollments and numbers of teachers by level and sector in the *Projections of Education Statistics*. State-level data have been reported in the *Digest of Education Statistics*, which includes tables showing state-by-state

statistics on enrollments and numbers of teachers for the most recent year for which those data were gathered. As an indication that CES's data base is becoming out-of-date for these purposes, the most recent state-by-state listing of private school enrollments and numbers of teachers in the *Digest* is for Fall 1980 (CES, 1987).

A convenient way for CES to get national data on enrollments and numbers of teachers by level and sector is to aggregate counts supplied by the states, but the state counts must come directly or indirectly from the individual schools. For the public schools, these counts are gathered by the state education agencies and are available in CES's Common Core of Data. The lack of similar counts (or reliable estimates) for the private schools is a significant gap in the CES data base that has important ramifications for designing surveys of the nation's teaching force. We defer a more detailed discussion of this problem to Sec. VIII, where we recommend that a "private school directory" be created to serve many of the same functions for the private schools that the Common Core of Data serves for the public schools.

The teacher subpopulations within each state corresponding to the four school level/sector combinations (elementary/secondary, public/private) constitute essentially separate labor markets that would be worthwhile distinguishing even if the present distinctions did not exist. Secondary teachers as a group have little in common with elementary school teachers and, with the exception of the junior high teachers who sometimes bridge the gap, few teachers move from the secondary to the elementary level or vice versa. The private schools, which are ordinarily free of the teacher certification standards that public schools must follow and which generally offer teachers a different educational climate from the public schools (including lower pupil/teacher ratios on average), serve as an alternative labor market for teachers that may have markedly different compensation levels, turnover rates, and sources of teacher supply. Thus, the distinction between the teacher forces in the private and public schools is natural.

For public school teachers, state lines constitute boundaries of labor markets that are more pronounced than for other occupations because of the certification standards and other requirements that out-of-state applicants must satisfy before they can teach. Differences in state policies regarding teachers may be reflected in differences in compensation levels, teacher qualifications, and turnover that must be taken into account in making projections and in drawing implications from cross-state comparisons for policy purposes. Also, state policies affecting the public schools, such as course requirements for high school graduation and minimum-competency testing standards, may have a substantial effect on the demand for teachers in certain fields.

Within each of the four school-level/sector types in each state, the breakdown of teachers by field constitutes a further division of the teaching force into mini-labor markets that may have quite different turnover rates because of the greater demand and higher wage scales for teachers in certain fields whose special skills are marketable outside of teaching. For example, it is reported that few computer science teachers, who ordinarily have good programming and mathematical skills, remain in teaching beyond the first year.

Fragmentary evidence of field-specific staffing problems indicate that the coming crisis in teaching is already here, and that the schools have entered a new period in which teacher demand will outstrip supply in many fields (Darling-Hammond, 1984). At the elementary level, substantial shortages of bilingual education and special education teachers have been reported for some time. At the secondary level, some recent studies have pointed to a shortage of qualified teachers in science and mathematics (National Science Board, 1985, Chap. 6), and a national commission has proclaimed that this shortage is adversely affecting the quality of education (National Science Board Commission on Precollege Education in Mathematics, Science and Technology, 1983). Unfortunately, definitive field-specific data on teachers to establish or refute these claims do not exist at the national level.

In addition to needing national data to address these issues, there is also a need for field-specific estimates of shortages, teacher qualifications, turnover, and sources of teacher supply by state, level, and sector that will permit isolating staffing problem areas and assessing their severity. It should be noted that, whereas we have stated the need for reliable *counts* of teachers by state, level, and sector, we are not recommending that CES undertake an effort to get a precise breakdown of these counts by field. Instead, we recommend that CES redesign its surveys to get reliable *estimates* of numbers of teachers by field. Our recommendations along these lines are outlined in Sec. VIII, as are our recommendations for providing the requisite field-specific data to provide assessments and projections of teacher supply and demand components by field.

TEACHING ASSIGNMENTS AND QUALIFICATIONS

We envision that large, representative samples of teachers will be surveyed within each school level, sector, and, preferably, state, that will permit estimating the proportions of teachers in various categories, including those corresponding to subject matter fields. One purpose in getting precise information on teaching assignments, including a listing

of classes taught, the modal grade level of students in each class, and the class size, is to facilitate classifying the teachers by field. Those who teach three classes of algebra and three classes of French, for example, would be classified as being half-time in mathematics and half-time in foreign languages for the purposes of estimating counts of teachers by field. (Here, as is usually the case throughout this report, "counts of teachers" refers to numbers of FTEs.)

Information on teaching assignments is also required for other purposes. To ascertain the extent to which uncertified, substitute, part-time, and itinerant teachers are used to meet staffing exigencies, we need information about the teachers' statuses. To determine whether shortages in certain areas engender more out-of-field teaching, we need to be able to contrast teachers' fields of assignment with their fields of preparation.

Our data requirements need to anticipate the provision of several measures of teacher "quality," an area of great concern and a difficult area to fathom in the absence of good measures of student progress along several dimensions and comprehensive information about all the factors other than teacher attributes that affect that progress. To provide indicators of teacher *quality*, we require several measures of teacher *qualifications* that, in combination, may serve as proxies for quality: teaching experience, certification status, fields qualified to teach, academic background, and special training. In particular, this information will permit determining each surveyed teacher's subject matter field, so that those teaching out-of-field can be identified.

DEMOGRAPHIC AND ECONOMIC CHARACTERISTICS

Age, race, and sex are standard items in population surveys, and they are important items in teacher surveys. Teacher turnover is related to age, in that young teachers are more likely to leave teaching than mid-career teachers, and older teachers are more likely to retire. As was discussed in Sec. II, women and minorities have long been overrepresented in the nation's teaching force. But opportunities for female and minority college graduates in nonteaching fields have been growing over time, and teaching may no longer be as attractive to them as it once was.

In the past, women viewed teaching as a career that was compatible with homemaking and raising a family. Many women taught school until just before they became mothers, dropped out of teaching (or participated on a part-time basis) until their children were of school age, and then returned to full-time teaching. That career pattern is surely

less prevalent today with more than half of all mothers in the labor force, but there remains the hope that the reserve pool of former teachers contains large numbers of homemakers who might be recruited back into teaching to offset some of the shortages that appear to be in the offing.

To better monitor the transitions between teaching and homemaking as well as to understand flows into and out of teaching more generally, we require additional information about teachers' marital and family statuses, including number of children, number of dependents, and age of the youngest child.

We also require information about the financial status of teachers, including the teacher's base annual contract salary, additional pay for school-related activities, earnings from summertime employment and second jobs, spouse's income, and total family income. These data, when combined with information about the teachers' marital and family statuses, will permit us to examine teachers' salaries in the larger perspective of family income and responsibilities, and to draw comparisons between teachers and other college-trained workers. For the latter purpose, it is important to gather earnings and income data on teachers which will be comparable with that reported for other occupations, such as the earnings and income data gathered in the decennial censuses and the Current Population Surveys.

SOURCES OF TEACHER SUPPLY

To assess current teacher supply and to provide projections of future supplies by component, we need time series estimates, preferably by field, level, and sector, of the number of new teachers by supply component (i.e., entrants from the teaching pipeline, reentrants from the reserve pool, or immigrants). Data requirements for gauging the fourth source of supply, the continuing teachers, will be considered in treating teacher turnover.

One way to gather data on sources of teacher supply is to ask teachers about their previous job experiences and educational backgrounds. Since this information is also needed for assessing teachers' qualifications, no additional data are needed. One advantage of this method of gathering supply source data is that not only are the supply sources of new teachers elicited, but also those of the experienced teachers who remain in the force.

Another convenient means for getting source of supply data was the one used in the School Staffing Survey for 1968–69 (Metz and Fleischman, 1974) in which the principals from a sample of 1,205 public

schools were asked to give a breakdown of the additions to their teaching staff during the school year 1968–69 by the following categories (as they were listed on the survey instrument):

1. New teachers (i.e., those who have never had a full-time teaching assignment before).
2. Teachers in another school last year:
   a) in this school district.
   b) in another school district.
3. Teachers returning from leave of absence which began before the first Fall report date, 1968.
4. Other additions whose previous status is known (specify).
5. Other additions whose previous status is unknown.

SOURCES OF TEACHER TURNOVER

In the same survey, the principals were asked to provide counts of teacher turnover by component in a way that, if this procedure had been used every year thereafter, would have provided the time series on teacher turnover that is sorely needed for making projections of teacher demand. The categories of "separations," as they were listed on the survey instrument, were as follows:

1. Leave of absence
2. Changed to teaching job in another school:
   a) in this school district.
   b) in another school district.
3. Changed to a nonteaching job *in* education field.
4. Changed to a job *outside* of education field.
5. Retired.
6. Deceased.
7. Other separations whose reason for leaving is *known* (specify).
8. Other separations whose reason for leaving is *unknown*.

In our view, data of this type are absolutely essential for monitoring teacher supply and demand by component, and for providing meaningful projections. Given that the data for any year could be gathered using a one-page mailout form, that the responses could be readily processed on a timely basis, and the complete processing costs would be low, we wonder why surveys devoted to gathering these data have not been conducted since 1969.[1] Except perhaps for the overall counts of

[1]The efficiency of this approach to collecting turnover data is little compromised by the fact that school principals do not have perfect knowledge of the destinations of all

teachers by level and state, no other data on teachers are more critical for assessing and projecting teacher supply and demand.

Perhaps one reason that these data have not been gathered is that, whereas they permit estimating overall supply and turnover rates by component, they do not permit estimating corresponding rates for subpopulations of teachers categorized by field, age, sex, and years of experience. The most important of these for supply/demand projection purposes is field. Location, school level, and sector are also important, but they are identified in school-level data. The composition of the teaching force by age, sex, and years of experience is relatively stable over time. Hence, if counts of staff additions and losses could be obtained by field or for just the critical fields (say, science and mathematics in the secondary schools, and bilingual education and special education in the elementary schools), then this option could be pursued as a way of filling a crucial gap in the data base on teachers.

As mentioned in Sec. IV, finer-grained analyses of patterns of teacher turnover by teacher type and destination can be supported by a follow-up survey of teachers leaving from the baseline teacher samples.

INDICATORS OF TEACHER SHORTAGES

We have already discussed the need for individual-level data on teachers' qualifications and assignments to examine the "quality" of the nation's teaching force and assess the extent of out-of-field teaching. Because the existence of marginally qualified and out-of-field teachers on a school's faculty often indicates an inability to attract fully qualified teachers in those fields of assignment, data from individual teachers constitute indirect measures of shortages of qualified teachers.

To provide more direct measures of staffing problems, district- or school-level data on shortages defined in terms of unfilled vacancies are also needed. At present, counts of shortages by level and field are elicited in the Survey of Teacher Demand and Shortage. In the past, the questionnaire has been structured so that two types of shortages are measured. First, there were field-by-field counts of the "number of teaching positions that remain vacant, were abolished, or were transferred . . . because a suitable candidate was unable to be found." Second, there were the implicit shortages of *qualified* teachers reflected by the numbers of teachers who do not hold regular or standard certification in their fields of assignment.

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teachers. In the 1969 survey, for example, only 8 percent of leaving teachers were classified as "separations whose reason for leaving is unknown" (Metz and Fleischman, 1974).

These counts provide valuable measures of the "unmet demand" for teachers and of the overall quality of the teaching force as measured by certification status. Also, the counts of FTE teachers by field gathered in these surveys provide more timely, if less precise, estimates of numbers of teachers by field of assignment as compared with those obtained through surveys of individual teachers that permit finer categorization of teacher assignments.

To provide better indicators of staffing problems, we have recommended that the counts of teachers obtained in the Survey of Teacher Demand and Shortage be expanded slightly to break out the counts of new teachers and the numbers of uncertified new teachers in each field. Since the proportion of uncertified new teachers in any field is an indicator of the quality of the current supply of teachers in that field, these data provide a means for detecting and gauging imbalances in teacher supply and demand by field. For this purpose, in fact, data on the certification status of newly hired teachers by field are perhaps more important than data on the certification status of all current teachers, since older teachers may be uncertified or assigned out-of-field for many reasons other than labor shortages.

In lieu of hiring marginally qualified teachers to fill vacancies, another option that some schools might pursue is that of increasing class sizes or relying more on part-time, substitute, or itinerant teachers. Measures of the extent to which these practices are followed can be derived from district- or school-level data that include enrollments and staff sizes for both the current and previous year as well as aggregate counts of teachers and other school personnel by major assignment area.

INFLUENCES ON TEACHER SUPPLY AND DEMAND

In addition to providing field-by-field shortage data and counts of (and certification statuses of) new and experienced teachers, the Survey of Teacher Demand and Shortage can also be used to monitor personnel and curricular policies that influence teacher supply and demand at the local level. For example, we have recommended that information be obtained about changes in program or course requirements that affect the demand for teachers of various types; salary schedule information; hiring policies (tests, certification, etc.); and retirement policies (e.g., minimum and maximum ages for retirement).

At least in theory, information on teacher qualifications and shortages can be used in conjunction with this additional information about school personnel and curricular policies to analyze the extent to which

staffing problems are related to school policies. For such an analysis to be fruitful, it would be necessary to incorporate additional information about school and student characteristics as well as local labor market conditions that might affect teacher supply and demand.

Although it is conceivable that information for an analysis of this type might be gathered through an expansion of the Survey of Teacher Demand and Shortage or through the inclusion of items on the administrators' part of the Public and Private School Surveys, a comprehensive analysis of the complex interrelationships among teacher turnover, teacher supply, district policies, and school administrators' responses to staffing problems is a difficult undertaking with extensive data requirements that may not be feasible to satisfy using national surveys. In Secs. IV and V we described the kinds of analyses that might be supported by adding specific policy indicators to the Surveys of Teacher Demand and Shortage. We stressed that data from different sources are needed for analyses of particular types and that no single source will answer all of the important questions concerning supply and demand. In the next section, we examine some of the problems associated with analyzing teacher flows and turnover in the context of discussing a follow-up survey of those who have left teaching and other options for gathering data on teacher flows.

VIII. OPTIONS FOR MEETING DATA REQUIREMENTS

This section examines options that CES might pursue to satisfy the data requirements outlined in the previous section. First, some comments are in order about the meaning of the expression "data requirements."

Up to this point, we have taken the viewpoint that CES needs a data base that permits profiling the nation's teaching force accurately along several dimensions related to teacher supply and demand. If, as we believe, the nation faces a crisis in teaching because of impending shortages in some fields and some locations, CES needs to revamp its data base on teachers to provide comprehensive, up-to-date information on teachers to monitor the severity of staffing shortages over time and to provide projections indicating the extent of future shortfalls in teacher supply. In our view, CES *requires* such data in the future, even though steps have not been taken to acquire similar data in the past.

Beyond the basic data needed for these purposes, additional data on teachers may be *required* or *desired* for other purposes. Although we feel that the distinction between data *requirements* and *desiderata* is an important one, making that distinction entails setting priorities on data elements, and that is beyond our purview. In the preceding section, we outlined the data requirements that we deem most important for assessing the nation's supply of and demand for teachers. We now turn to the task of outlining options for meeting those requirements.

OVERALL COUNTS OF TEACHERS

Reliable time series of counts of FTE teachers by state, level, and sector are of fundamental importance for monitoring and projecting teacher supply and demand. At present, CES relies on the Common Core of Data (CCD) to provide counts of teachers for the public schools, but no procedure currently exists for getting analogous counts for the private schools. As a preliminary to discussing how this critical gap in the data base can be filled, we first examine the information available in the CCD on pubic school teachers.

The CCD contains fall enrollments by grade level and counts of FTE teaching staff and other school personnel by major assignment category. The state and national counts are derived by aggregating

counts across local education agencies, which in turn depend upon counts for individual schools. In theory, if not in fact, a complete listing of the nation's public schools exists in the CCD giving each school's name, address, staff size, and enrollments by grade and level. Hence, aggregate counts of teachers, enrollments, and pupil/teacher ratios can be provided for any subset of public schools defined in terms of geographical areas, enrollments, or staff size. Moreover, the listing of public schools and their attributes can serve as a sampling frame for choosing stratified samples so long as the strata are defined in terms of enrollments, staff sizes, or community attributes that can be imputed from school addresses. In particular, a school's zip code can be used to classify the school as urban, suburban, or rural.

At present, CES has no comparable listing of private schools. Numbers of teachers and enrollments in private schools are currently estimated using results from the Private School Survey. The process entails first drawing a probability sample of schools from an incomplete sampling frame, which permits estimating the total number of teachers and the total enrollment of schools listed on the frame. To estimate the numbers of teachers and enrollments in the private schools that are not listed on the frame, a supplemental area sample of primary sampling units (PSUs) is chosen, and an exhaustive search for private schools is made within each selected PSU using state school directories, yellow pages of telephone directories, and contacts with school officials, churches, chambers of commerce, etc. Final population estimates are then calculated based on the number of additional schools found, their enrollments, and their staff sizes (Westat, 1984).

By the very nature of this procedure, the estimated population totals are subject to considerable sampling error. CES reported a 95 percent confidence interval for the number of FTE teachers in 1983 that ranged from 319,500 to 354,800—an 11 percent spread. The analogous confidence interval for the number of private schools ranged from 26,300 to 29,105, and the one for total enrollment ranged from 5,479,000 to 5,951,000. As an indication that earlier population estimates for the private schools were unreliable too, CES's previously reported estimate of 277,400 FTE teachers in 1980 was adjusted upward to 301,000 on the basis of results from the supplemental area search conducted in 1983. Since the 1985 Private School Survey used the same sampling frames that were used in 1983, CES has had no reliable population estimates for the private schools since before 1980 (if then), nor will it have them again until the procedure for gathering data from the private schools is changed.

To lay a basis for getting reliable counts of private school teachers and students in the future, we recommend that CES create a "private

school directory" that, like the Education Directory for Colleges and Universities, contains the name, address, and affiliation of each school and provides the same basic data on staff sizes and enrollments by level that are now available for the public schools in the CCD. Given such a directory, one could aggregate the individual school statistics to any level (e.g., by state and affiliation). Also, the directory could serve as a sampling frame for future surveys in which the private schools serve as sampling units.

DISAGGREGATED COUNTS OF TEACHERS

Assuming that a private school directory will be created or that additional steps will be taken to get accurate annual counts of teachers by state, level, and sector, we turn to the problem of getting reliable *estimates* of the numbers of new and experienced teachers by field and certification status by state, level, and sector. Here, two approaches are available, both of which involve revising surveys previously fielded by the CES. Below we discuss those surveys and present our recommendations for changing them to meet future data requirements.[1]

Surveys of Teacher Demand and Shortage

The first approach for getting counts of teachers by field and certification status is to use data from the Surveys of Teacher Demand and Shortage. For the public schools, the sampling unit for this survey is the local education agency (LEA). For the private schools, it is the school itself. In the most recent previous fielding of these surveys (in 1983–84), 2,540 LEA personnel administrators and approximately 1,000 private school principals were surveyed to get counts of FTE teachers in the cells of two matrices (one for elementary teachers and one for secondary) in which the rows correspond to fields and the columns correspond to categories of teachers by certification status. A separate column is provided for listing counts of unfilled vacancies by field.

The 1983–84 survey also included questions as to whether the school districts and private schools were using particular types of teacher incentive plans. In future fieldings of this survey, we have recommended that the surveys be expanded to get more precise information on school staffing problems as they are reflected in counts of unfilled vacancies and uncertified teacher by field and level. The specific changes are as follows:

[1]These recommendations have been incorporated into CES's new Schools and Staffing Surveys to be fielded in 1988.

- Add two additional columns to the arrays to obtain analogous counts of new teachers by field and certification status. These counts, in conjunction with the counts of unfilled vacancies by field, provide key indicators of supply shortfalls.
- Include counts of other professional staff (counselors, librarians, administrators, etc.) to provide a fuller picture of district staffing patterns and demand for school staff.
- Collect information on personnel and curricular policies (e.g., changes in program or course requirements for graduation, and salary schedule information) that affect the supply of teachers and the demand for teachers of different types.
- Get data on total enrollment and total number of teachers for the previous year, as well as the current year, to permit estimating the components of growth in staff size attributable to enrollment changes and to changes in pupil/teacher ratios (see Sec. VI).

An obvious shortcoming of the Surveys of Teacher Demand and Shortage is that the data are gathered as counts in cells that do not permit fine distinctions. Breakdowns of numbers of teacher by certification status provide only crude indicators of staff qualifications. Also, the field classification of a particular teacher, based on information in the school or district personnel file, may be ambiguous; it may be the assignment field or the field of preparation (more likely the former). Moreover, data in personnel files may not permit identification of teachers whose assignments straddle two or more fields or those who teach at both the elementary and secondary level. Hence, for some purposes, more refined data from the teachers themselves are required.

Surveys of Public and Private School Teachers

The "teacher part" of the Public and Private School Surveys (which also include an "administrator part") elicits information from the teachers themselves about their characteristics, qualifications, teaching assignments, and other duties. In the most recent fielding of these surveys (1985 for public school teachers and 1986 for private school teachers), teachers were sampled from the same schools that were sampled for the administrator surveys. In the Public School Survey, approximately 11,000 teachers were sampled using a national probability sample of 2,800 public schools (1,300 elementary, 1,300 secondary, and 200 other) using cluster samples that averaged four teachers per school. In the Private School Survey, about 9,000 teachers were sampled from 1,500 schools (about six per school).

The teachers in the Public and Private School Surveys were asked to give detailed information about their teaching assignments, including a listing of classes taught, the modal grade level of students in each class, and the class size. These data permit finer and more accurate classifications of teachers by field and level. To make better use of these data for assessing teacher supply and demand, we have proposed augmenting the content of the surveys in several areas, three of which bear importantly on supply and demand issues:

- *Teaching Qualifications.* Data on teacher qualifications (certification status, fields qualified to teach, academic background, and special training) are important for monitoring teacher quality. Although previous surveys collected data on some aspects of teachers' academic backgrounds, we recommend adding more detail on other aspects of training (e.g., graduate and in-service training).
- *Work Histories of Teachers.* Besides providing information on teaching experience, work histories permit identifying sources of teacher supply, monitoring accessions from the reserve pool, estimating mobility, and examining the career paths of teachers.
- *Career Plans.* Data on teachers' career aspirations, their plans for next year, and their reasons for pursuing (or not pursuing) teaching as a career provide information for gauging commitment to teaching and isolating categories of disaffected teachers and potential leavers.

Given the wealth of personal information that can be obtained using surveys of individual teachers, one might well ask why district and school surveys should even be considered in attempts to get counts of new and experienced teachers by level, field, and certification status. The answer is that the counts gathered at the district level constitute complete counts of the teachers at that level, so that each response is tantamount to a summarization of perhaps hundreds or even thousands of individual teacher responses, albeit on a limited number of categorical items. A sample of 10 districts averaging 200 teachers per district provides data on 2,000 teachers. Since the costs of fielding and processing 10 survey forms from district administrators are commensurate with the costs of fielding and processing 10 teacher questionnaires, surveys of districts and schools are clearly more efficient; they afford far greater coverage of the teacher population, entail much less follow-up and processing time (and, hence, engender more timely results), and within-cluster sampling errors are eliminated. Insofar as their relative

merits in providing disaggregated data on teachers, both types of data-gathering efforts have their places, and we feel that both types of surveys are needed for creating a suitable data base on teachers.

DEMOGRAPHIC AND ECONOMIC CHARACTERISTICS

The demographic and economic characteristics that teachers were asked to report on the previous Public and Private School Surveys are age, sex, race, and certain types of income. In the Public School Survey, the income items are base annual contract salary, additional earnings for school-related activities, earnings from nonschool-related work, and additional pay from bonuses or step increases for agreeing to teach in a particular field or geographic location. In the Private School Survey, the income elements are academic year base salary, summer school salary, and earnings from nonschool-related activities.

To get more complete information about the financial statuses of teachers and to obtain income and earnings data comparable to those reported for other occupations, we recommend that the demographic and economic information gathered on teachers be augmented to include the teachers' marital status, number of children, number of dependents, age of the youngest child, and the following components of income: academic year salary, additional pay for school activities, earnings from summertime employment and second jobs, and total family income. These data will give a more complete profile of teachers' family and financial statuses, permit drawing comparisons with college-trained workers in other fields for which comparable data exist, and provide more comprehensive baseline data for use in analyses of attrition, mobility, and other types of turnover.

SOURCES OF TEACHER SUPPLY

There are several sources of information about the supply of potential teachers in the teacher pipeline: CES's data on earned degrees by field, data from the Survey of Recent College Graduates, the teacher supplement to the National Longitudinal Study of the High School Class of 1972, High School and Beyond, and data on undergraduate major preferences from surveys of entering college freshman. These sources can be combined to project numbers of college graduates prepared to teach, as is done for example in preparing the National Education Association projections.

To monitor current teacher supply and to provide time series for projections of other components of teacher supply (reentrants from the

reserve pool of former teachers and immigrants), we need good estimates, preferably by field, level, sector, and state, of numbers of new teachers by source of supply. One way to provide these estimates is through the use of surveys in which teachers are asked to supply information on their work histories and educational backgrounds. Earlier we recommended that the Public and Private School Surveys be expanded to include this information, so no additional requirement is needed.

A shortcoming of this approach is that only the supply source data on *new* teachers are relevant for the purposes of assessing current sources of teacher supply, and the number of new teachers surveyed in the Public and Private School Surveys may be too small to provide precise estimates. If, for example, the number of teachers surveyed is 50,000 and the proportion of newly hired teachers (including immigrants) is approximately 8 percent, as it was in 1983 (NCES, 1985b, p. 150), then the estimated number of new teachers in the sample would be 4,000.

Given that the number of newly hired teachers can be estimated precisely by level and sector from the population counts for total teachers by applying the estimated proportions of newly hired teachers derived from the Surveys of Teacher Demand and Shortage, the numbers of newly hired teachers by source can be estimated quite reliably using a sample of this size, but further breakdowns by field, level, and sector, could become more problematic.

Another means for meeting the requirement for source-of-supply data was mentioned in Sec. VII, namely, to sample school principals and ask them to provide a breakdown of the number of additions to their teaching staff by source of supply. (We previously recommended that the Survey of Teacher Demand and Shortage be changed so that counts of newly hired teachers by *field* will be elicited from LEA administrators and private school principals.) The analogous breakdown by source of supply can be readily obtained using an appropriate item in the "administrator part" of the Public and Private School Surveys, which implicitly covers a much larger sample of newly hired teachers. Since this survey includes a number of items related to teacher supply (e.g., information on school characteristics and teacher incentives), the data could presumably be used to perform school-level analyses of the dependence of supply sources on school conditions and policies.

DATA ON TEACHER TURNOVER

As we observed in Secs. VI and VII, timely data on teacher turnover are essential for assessing teacher supply and demand. CES projections of teacher demand, which assume a constant 6 percent rate of teacher turnover, lack credibility, because current national data to support the 6 percent figure do not exist. Even if such data did exist, the national figure is of little use by itself, because there may be substantial variability in turnover rates across fields, states, levels, sectors, and age groups.

To obtain teacher turnover data, we recommend asking principals to provide counts of leaving teachers by component as was done in the School Staffing Survey for 1968–69 (Metz and Fleischman, 1974), where the loss categories included leave of absence, change to a teaching job in another school, change to a nonteaching job outside the field of education, and retirement. As is the case for supply source data, this requirement can be met by including an item on the administrator part of the Public and Private School Surveys.

Though valuable for estimating overall turnover rates by level, school type, and location, the resulting data would provide very limited information about turnover by field of teaching to support field-specific assessments of supply and demand, say, for science and mathematics teachers. The danger in adding additional field-specific breakdowns of turnover to the principal's survey is that the survey instruments are already quite long and complicated, especially the one for the Private School Survey, and it is possible that adding more elaborated turnover items would risk higher nonresponse on the parts of the principals.

Recognizing the criticality of turnover data by field and having pretested items of this type satisfactorily, we have recommended that CES examine the practicability of including such items in their more extensive field tests of the Public and Private School Surveys. If nonresponse on these items proves excessive, we suggest that CES entertain fielding a special survey of principals to get counts of staff additions by source and losses by type, where the loss data are disaggregated by field. A survey instrument for gathering field-by-field counts of losses could be designed along the lines of the form currently used in the Survey of Teacher Demand and Shortage, where the fields are listed as the rows of the tables and the various types of losses appear as column headings. A version that might seem less formidable to principals would be to restrict the counts to fields in which shortages are matters of national concern, namely, science and mathematics in the secondary schools, and special education and bilingual education in the elementary schools.

In addition to gathering counts of teacher turnover from principals, another option that we have recommended is to gather data from individual teachers that can be used to analyze turnover as a function of teacher attributes and other factors that might affect teachers' propensities to discontinue teaching for a year or more. The nature of the study envisaged here involves treating the teacher sample of the Public and Private School Surveys as the base year sample for a follow-up survey of teachers who leave the force.

The idea is to return a year after the base year survey to each school that participated in the survey and identify the teachers who are no longer teaching at that school. One option would be to simply ascertain from the school administrator the reported reason for the teacher's leaving, thereby identifying the value of a polytomous (categorical) dependent variable that could be analyzed in various ways, using items taken from the base year survey as independent variables.[2] For example, analyses of teacher turnover by field, age, sex, qualifications, and school type (level and sector) can be carried out using data elements from the base year survey. Estimates of teacher turnover by destination and by school type can be derived from the counts of teacher turnover elicited from principals on the administrator survey.

A second option that we recommend is to follow up the teachers who leave and administer a second questionnaire to determine their current activities, earnings and income data, changes in family status, reasons for leaving teaching, future plans, etc. A third option that we favor is to follow up some subset of continuing teachers to serve as a comparison group. This would be necessary to make comparisons between teachers who leave and those who stay on such variables as salary levels, working conditions, and satisfaction with current employment. These options are part of the CES's current plans, assuming funds are available.

A fourth option is to make the study longitudinal by following up a sample of both leavers and continuing teachers for two or more years to reexamine their later employment behavior, perhaps to include reentry into teaching. The main argument for conducting a longitudinal survey in lieu of a one-time follow-up would be to ascertain the flows into and out of the teacher force over time with the aims of better understanding teachers' decisions regarding employment and determining how external factors affect those decisions. In particular, the main value of such a study would be to ascertain the rates at which departing teachers return to teaching from the reserve pool and the circumstances under which they do so.

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[2]For a review of multiple regression procedures for dichotomous or polytomous dependent variables, see Haggstrom (1983).

An obvious problem in conducting individual-level longitudinal studies to study changes in teachers' employment behavior over time is that the data requirements may be excessive. Consider the data needed for a study of teacher turnover as a function of teacher attributes (e.g., years of experience, age, sex, teaching field, field of preparation, educational attainment, salary level, marital and parenthood status, and family income) and other factors that might affect those flows (e.g., school policies, teacher certification rules in neighboring states, labor market conditions, job opportunities open to the individual, potential earnings streams in alternative occupations, and constraints affecting career choices). When one considers the costs of providing data to support comprehensive analyses of this type in terms of respondent burden, logistical problems associated with multiwave surveys, and the additional time and expense needed to plan the survey, administer the instruments, and process the results, it becomes clear that the benefits that accrue from the analysis must be substantial to offset the costs.

There are numerous possible objectives associated with turnover analyses that need to be sorted out, because they have very different implications for data requirements. Among the objectives are to (a) provide input for projections; (b) estimate dependencies of turnover and related variables (e.g., plans for next year and career plans) on teacher characteristics, school policies, and other factors; (c) examine correlates of turnover and teacher satisfaction; and (d) provide indicators of teacher morale, status of the profession, tightness of the teacher labor market, etc.

SOME ALTERNATIVES FOR ANALYZING TEACHER FLOWS

Depending on analysis objectives, it is worth considering whether the data requirements for analyzing teacher flows might be met in ways that do not entail expanding the teacher surveys or using longitudinal follow-up surveys. As we have already indicated, for the purposes of providing input to assessments of teacher supply and demand, one can rely on surveys of principals to obtain counts of additions to and separations from the teaching force by component.

As alternative sources of data for detailed analyses of teacher turnover, many states (e.g., Connecticut, Illinois, New York, and California) have state personnel files that can be exploited to analyze components of turnover. Most files permit identifying teachers who leave the state and include the main demographic characteristics needed for multiple regression analyses of turnover. These files can also be

supplemented by district data on economic conditions and characteristics of the school systems and pupils. Some states keep data on causes of turnover, so that voluntary and involuntary attrition can be separated, as well as returns to teaching in later years.

Given the diversity across states in factors related to flows into and out of teaching (e.g., certification standards, competency testing requirements, salary schedules, and nonteaching employment opportunities), one can argue that turnover should be analyzed state by state anyway and that the more complete and comprehensive state data bases better satisfy the data requirements for these purposes. State personnel files have the decided advantage over survey data of having very large sample sizes but do not afford the richness of information provided by surveys. For example, state files rarely have any information on private school teachers or on the employment activities of teachers who leave the state. In that sense the two data sources—state teacher files and national teacher surveys—complement each other.

Two other national data bases that may be useful for profiling the teacher force and analyzing teacher turnover are the Current Population Survey (CPS) and the Survey of Income and Program Participation (SIPP). Both are household surveys conducted by the Bureau of the Census. The CPS, which has served as the primary data source on employment and earnings for decades, gathers data on approximately 58,000 households each month covering approximately 120,000 individuals, of whom an estimated 70,000 are in the labor force. Since the nation's 2.5 million teachers constitute about 2.1 percent of the 120 million civilian labor force participants, there are approximately 1,500 school teachers in the CPS sample each month. Because of the rotating nature of the CPS sample (each surveyed household is in the survey for four months, out for eight months, and then in again for four more months) and the fact that one can use data for several years, the CPS provides a sizable data base on teachers that should be better exploited. Moreover, the CPS provides comparable employment, income, and demographic information on tens of thousands of individuals in occupations to which teachers might be attracted, as well as information on individuals who have been teachers but are currently out of the labor force. SIPP gathers more extensive data about employment characteristics and sources of income, but it uses smaller sample sizes. Unlike the CPS, each surveyed household in SIPP is reinterviewed at four-month intervals for nine successive interviews, thereby providing longitudinal information on teachers over a longer period of time.

A major shortcoming of the CPS and SIPP as sources of information on teachers is that the occupation codes on these files permit

identifying only five categories of teachers: prekindergarten and kindergarten teachers, elementary teachers, secondary teachers, special education teachers, and teachers not elsewhere classified. Although CPS and SIPP data permit profiling the teacher force by age, sex, race, marital status, earnings, and income, they do not permit analyses of teacher flows by field, school characteristics, and other factors. For these purposes, school-based surveys such as the Schools and Staffing Surveys are needed.

Because the objectives of analyses of teacher flows that *might be* entertained are too diverse to completely circumscribe their data requirements, and since alternative data bases might serve some analytic purposes better, we cannot fully prescribe data requirements for analyses of this type. However, in our view, the data requirements that we have specified for other purposes will provide a valuable data base on teachers that can be augmented by state data bases and other federal data bases for special purposes.

THE NEED FOR STATE-REPRESENTATIVE SAMPLES

Creating a data base on teachers that meets the data requirements outlined in the previous section would inevitably lead analysts to aggregate the individual-, school-, and district-level data to higher levels of aggregation for drawing comparisons of measures across states, sectors, and fields. In particular, tables showing state-level measures along the lines of those in the *Condition of Education* or those on the Secretary of Education's "Wall Chart" could be prepared to facilitate contrasting states in terms of pupil/teacher ratios, teachers' educational attainments, teacher turnover, shortages per thousand teachers, percentages of uncertified (or out-of-field) teachers, salaries, and family incomes.

Although we have qualms about providing the grist for ranking individual states in terms of these measures, we would have even greater concern if the statistics reported for some states were for a few schools or districts that were not "representative" of the schools in those states and, hence, distorted the overall measures for the state. To guard against that eventuality, it is important that any surveys that might be used to derive state estimates use "state-representative" samples and that data users be fully apprised of sampling schemes, sample sizes, sampling weights, and other information needed to calculate and interpret statistics on subpopulations of teachers.

Unfortunately, designing the surveys to meet those desiderata is easier said than done. First, "representative sample" is an undefined term that statisticians tend to avoid in formal writing (Kruskal and Mosteller, 1980), and the notion that statisticians associate with that

term (i.e., accordance between the joint distribution of the sample values of numerous variables and the corresponding population distribution) is difficult to put into operation. Several basic notions of sampling theory seem to underlie the term: random selection, proportional representation across strata, "representativeness" of the sampled units in terms of distributions of key attributes, and equal chances of sample selection among sample units within each stratum. Because of the multistage nature of the samples for the Schools and Staffing Surveys, these criteria, however they are spelled out, cannot be fully satisfied simultaneously at the district, school, and teacher levels.

Nevertheless, we feel that it is desirable to incorporate some constraints to assure that state-representative samples will be achieved in some sense. To be specific, we recommend that the samples of districts, schools, and teachers in each state be chosen so that (i) the sample and population mixes of public and private schools are the same, (ii) the representation of schools in key strata approximates their representation in the population, and (iii) the proportions of sampled teachers in certain categories approximate the population proportions in these categories. The latter can be achieved in large samples by sampling schools proportional to staff size within each of the sector/level categories and then choosing an equal number of teachers per sampled school. This yields "self-weighting" teacher samples within cells (i.e., each teacher has approximately the same chance of being selected to participate in the survey) and assures that, for any category of teachers in the cell, the expected number of teachers in the sample will be nearly proportional to the number in that category.

To devise a sampling plan for drawing "state representative" samples of schools (from which the teacher samples would also be drawn), one can follow Frankel et al. (1981), who operationalized the notion of representative sample in their *Sample Design Report* documenting the design for High School and Beyond. Like the teacher part of the Public and Private School Surveys, High School and Beyond used a two-stage stratified cluster design with the schools serving as clusters and the students within the schools constituting the second-stage units. Frankel et al. implicitly defined representative sample in terms of their representativeness along five dimensions that served as the stratification variables for defining the school strata: (1) type of control (public, Catholic, and non-Catholic private); (2) geographic region (the nine Census divisions); (3) racial and ethnic composition; (4) degree of urbanization (central city, suburban, and rural); and (5) enrollment size. Because the schools under consideration were all high schools, school level was not needed as a stratification variable in High School and Beyond, whereas it will be required in the teacher surveys.

The sampling plan that we have recommended to CES for fielding the Schools and Staffing Surveys differs from the High School and Beyond scheme in several respects. First, states, not regions, constitute the major strata, with four cells per stratum defined by level (elementary and secondary) and control (public and private). Second, we recommend using substantially larger school samples with a prescribed minimum of 50 (and preferably 60) public schools per state[3] and with the number of private schools chosen in each state so that the sample proportion of private schools equals the state proportion.

To permit linking the school and district survey responses in the public sector and to facilitate implementing the surveys, we have proposed a three-stage probability sample for the public sector where the primary units are LEAs or clusters of LEAs,[4] the second-stage units are schools, and the third-stage units are the individual teachers within the schools. For the private schools, where educational units analogous to LEAs do not exist, we propose a two-stage cluster sample with the schools serving as primary units.

To outline the public sampling scheme in somewhat simplified terms, consider a state in which the LEAs are relatively homogeneous in terms of their mixes of elementary and secondary schools, and in which LEA staff size is a good proxy for urban/rural status, so that the largest LEAs are in large metropolitan areas and the smallest LEAs are in rural areas. Then a convenient way to choose the public sample is to (1) order the LEAs by size; (2) use the Madow sampling scheme (systematic sampling following a random start) to choose the LEA sample proportional to size; (3) in each sampled LEA, except the very large ones (for which larger school sample sizes are prescribed), choose one elementary and one secondary school with probabilities proportional to school size; and (4) choose 10 teachers at random in each of the selected schools.

This scheme assures that schools and teachers in large, medium-sized, and small LEAs will be proportionately represented in the sample. Also, choosing two (or more) schools for the public school sample

[3]These figures were proposed at a time when the overall school sample size under consideration at CES was 6,000, of which approximately 4,500 would be public schools and 1,500 private. If CES decides to field the surveys using much larger sample sizes, we would recommend that the state minimum be raised somewhat.

[4]In some states, LEAs may consist of a single school and others may contain only elementary or secondary schools, but not both. In these states, we recommend preliminary clustering of LEAs to form primary sampling units consisting of contiguous LEAs that contain at least one elementary and one secondary school. This can be done by using the LEAs with secondary schools as the nuclei for clusters and adjoining other LEAs to the "closest" LEA with a secondary school, where closeness is defined in terms of the county and zipcodes of the LEAs.

in the same LEAs that participate in the Teacher Demand and Shortage Survey will reduce contact time in fielding the surveys and will produce linked responses needed for some analyses.

Two noteworthy features of the scheme are that (a) equal numbers of elementary and secondary schools will be chosen in each state, and (b) the schools will be implicitly stratified by *district* staff size—a proxy for degree of urbanization in most states. This assures that the schools in the sample will come from a diverse set of LEAs and will be broadly representative of all schools in the state, but with some oversampling of secondary schools. All teachers will have nearly the same probabilities of sample selection, so that the expected numbers of urban (or rural) teachers in the sample will be proportional to the total staff sizes in urban (or rural) schools. In sum, the LEA, school, and teacher samples chosen in this way will have some claim to be called "state-representative samples."

IX. CONCLUSIONS

At present, the data base on teachers at CES is inadequate to assess the current condition of teaching, and it is even less adequate for assessing the future outlook for teacher supply and demand. Fragmentary evidence from other sources indicates that, if the nation's schools are not already experiencing substantial shortages of qualified teachers in certain areas, they will soon. Because of the lack of the most basic information about teachers—their numbers, qualifications, financial statuses, and employment patterns—the breadth and severity of the school staffing problems are, for all practical purposes, unknown. Not knowing how teachers stack up today and having only the crudest barometers for monitoring changes in the teacher workforce, we are at a loss to say how severe the staffing problems will become in the immediate future.

This study has taken a hard look at CES's data-gathering efforts for monitoring and projecting teacher supply and demand to answer two fundamental questions. First, what information currently exists on teachers and the teacher labor market? Second, what data-gathering efforts should be undertaken to provide the information needed to profile the current teaching force, monitor staffing problems, and gauge the outlook for the future?

We have concluded that, in the main, the four surveys that we have contracted to help redesign are the right types of data-gathering efforts needed to fill CES's information gaps regarding teaching. However, to create the data base that CES needs to monitor present and future staffing problems, these efforts must be reoriented to focus on key dimensions of teacher supply and demand, and some additional efforts will be needed.

Section VII discussed the data requirements that we feel are most important to assess the condition of teaching, monitor shifts in the teacher labor market, and provide projections of teacher supply and demand by level, sector, and field that will permit isolating shortages and guide educational decisionmakers at all levels of government and in the private sector. In capsule form, here are the main data elements for which consistent time series of measures are needed:

- Reliable counts of teachers and enrollments by grade level in all public and private schools;

- Estimates of numbers of teachers by field and certification status, and source of supply;
- Estimates of teacher shortages by field;
- Teacher turnover by field;
- Data from individual teachers on their teaching assignments, qualifications, work history, demographic characteristics, marital and family status, and sources of personal and family income; and
- Follow-up data on former teachers to determine reasons for leaving, current activities, salary and income levels, and plans for reentry into teaching.

With the exception of the counts of teachers and enrollments for all public and private schools, the other statistics referred to are estimates to be derived from samples of schools, districts, teachers, and principals that will permit comparisons across states, levels, and sectors on key indicators related to teacher supply and demand.

Section VIII discussed options that CES might pursue to meet these data requirements. The main options that we recommend are:

- Create a "private school directory" that lists the names, addresses, enrollments by grade, and numbers of teachers for private schools, so that information on these schools will be comparable to that for public schools in the Common Core of Data;
- Expand the Surveys of Teacher Demand and Shortage to obtain counts of new teachers by certification status and field, counts of other professional staff, and year-to-year changes in enrollment and staff sizes;
- Expand the Public and Private School Surveys of individual teachers to obtain more detailed information on teacher qualifications, work histories, marital and family status, and sources of income;
- Survey school principals to obtain counts of new teachers by sources of supply, and data on teacher turnover by field and reason for leaving;
- Implement a one-year follow-up survey of former teachers to ascertain their characteristics, reasons for leaving, current activities, and future employment plans, along with a follow-up of a subsample of continuing teachers; and
- Adopt sampling plans that provide "state-representative" samples and enhance cross-state comparisons.

We believe that implementing these changes, pursuing similar efforts on a regular basis, and taking steps to insure that the results of the efforts are made available on a timely basis will go a long way toward creating the data base on teachers that is so urgently needed for dealing with the coming crisis in teaching.

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